KNOWLEDGE
AN ILLUSTRATED MAGAZINE OF SCIENCE, LITERATURE & ART.

Founded by RICHARD A. PROCTOR.

VOL. XXIV.] LONDON: JUNE, 1901. [No. 188.

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ANTARCTIC EXPLORATION.

By WM. SHACKLETON, F.R.A.S.

(Physicist and Astronomer to the National Antarctic Expedition).

HISTORICAL.

NOT long ago a young reporter, evidently in search of copy and the Commander of the National Antarctic Expedition, was making vain enquiries for Captain Cook at the rooms of the Royal Geographical Society. Were that great navigator alive no doubt he would be the first to withdraw the opinion expressed by him "that no man will ever venture farther than I have done, and that the land to the south will never be explored. . . . ."

Cook reached the 71st parallel of south latitude in 1774, and nearly half a century elapsed before this was surpassed by Weddell, who reached 74° 15′ south latitude in 1823. A period of 18 years brings us to the memorable expedition under the command of Sir James Ross, who in 1841 passed the highest point in southern latitudes hitherto reached, and eventually attained the high latitude of 78° 4′ S., and even then was greatly disappointed at not being able to reach the 80th parallel, further progress southwards being rendered impossible by the great ice barrier.

Although Ross coasted along the great ice barrier for 450 miles in search of an opening to the southwards none could be found, nor does it appear that it was ever of such form as to permit a landing, being described as "a perpendicular cliff of ice between 150 to 200 feet above the level of the sea, without any fissures or promontories on its even seaward face." Upwards of 50 years have again elapsed before this has been penetrated by the members of the recent expedition sent out in the "Southern Cross" by Sir George Newnes, who found the barrier somewhat changed in position from that reported by Ross, and actually made a journey of 20 miles to the southward over it, reaching 78° 50′ S. There is no reason to suppose that Ross was mistaken in his determinations of positions, the accuracy of his observations being beyond praise. Our knowledge of the cycle of terrestrial changes in these regions is so meagre that no one can predict the magnitude of the change taking place half a century later.

FIELD OF OPERATIONS.

The two principal expeditions about to start for the Antarctic regions are under the auspices of the British and German Governments, and by mutual agreement they have decided to confine their attention to particular localities. The British expedition has had that half of the Antarctic area assigned to it which Sir Clements Markham has designated "the Ross and Victoria Quadrants," lying to the south of the Pacific and Australasia, between the meridians of 90° W. to 180° and 180° to 90° E. The German expedition will

Map.—Antarctic Area, showing allotments of the two Expeditions.

devote its attention to that half diametrically opposite, that is to the Indian Ocean and Atlantic side. The area comprised under this scheme is some 6 million square miles, larger than the whole of Australia; and so vast is the region that probably the two expeditions will be nearly 2000 miles apart.

THE BRITISH SHIP.

The ship to convey the party from these shores is the

"Discovery," and is the first ship which has been specially built in this country for such Polar work. She has a displacement of 1500 tons, with engines of 450 h.p., and to suit her for a magnetic survey, no metals with magnetic properties were allowed in her construction within a radius of 30 ft. from the magnetic observatory, situated on the upper deck.

The ship, of which we give an illustration, is expected in the Thames about the end of May, and will lie in the East India Docks to receive the supply of stores and instruments.

Whilst the expedition is planned for a couple of years she will be provisioned for three, should a prolongment be necessary.

Antarctic Ship "Discovery" at Dundee (without masts).
Photograph by R. W. SKELTON, R.N.

PERSONNEL.

The staff of the expedition is as follows:—Captain R. F. Scott, R.N., is the commander. Lieutenant A. B. Armitage, R.N.R., second in command, and navigating officer (of the P. & O. Company). Lieutenants C. Royds, R.N., M. Barne, R.N., and E. H. Shackleton (of the Union Castle Line Company). Mr. R. Skelton, R.N., chief engineer.

The scientific staff consists of Mr. T. V. Hodgson, formerly of Plymouth Biological Laboratory, biologist; Dr. R. Koettlitz, of the Jackson-Harmsworth Expedition, chief medical officer and botanist; Mr. W. Shackleton, from the Solar Physics Observatory, Royal College of Science, physicist and astronomer; Dr. E. H. Wilson, of St. George's Hospital, medical officer for the landing party and zoologist, and a geologist yet to be appointed. The three latter will, it is intended, be put on shore with some half dozen of the crew to form a land party. Mr. George Murray, F.R.S. (the editor of the Antarctic Manual), will proceed with the ship as far as Melbourne; and during the voyage out he will give the officers the benefit of his experience in sounding and dredging, as a preparation for similar work in the Antarctic area.

OTHER EXPEDITIONS.

Three other expeditions are in contemplation, one of which, that from Germany, is of similar magnitude to the British. The other two, one from Sweden, the other from Scotland, are of smaller dimensions.

The German ship, the "Gauss," has like features to the "Discovery," and is being fitted out at Kiel. Her programme will be carried out under the direction of Professor Erik von Drygalski, who has already done Polar work in his study of the Greenland glaciers. He will be assisted by four other scientific men.

The ship will be under the command of Captain Hans Ruser, with Herr A. Steho as engineer (both of the Hamburg-American Line).

The Swedish Expedition is led by Dr. Otto Nordenskiöld, of Upsala University. One naturally associates his name with Baron Nordenskiöld, and the discovery of the N.E. passage in the voyage of the "Vega," and he is indeed the nephew of that distinguished explorer, and has himself been on expeditions to Greenland and Alaska. His ship is the "Antarctic," and it is contemplated that in addition to Dr. Nordenskiöld she will have six scientific men on board, as well as the captain, officers, and crew. It is intended that the voyage will be made *viâ* Terra del Fuego, and that the vicinity of the S. Shetlands will form the arena of operations.

The Scottish Expedition is to be under the leadership of Mr. Wm. S. Bruce, who has already visited these regions in the barque "Balæna." The plans of this expedition are, however, not so far advanced as those above, but it is understood that Weddell sea will be its destination.

PROGRAMME OF THE EXPEDITIONS.

Whilst the British and German ships form the principal expeditions, the others will also support and act in harmony with them. Simultaneous observations will be made of various phenomena on term days, which have been decided upon by the committees.

For magnetic work the Cape and Melbourne will form the base stations for the "Discovery," and the Germans have decided to establish a similar station at Kerguelen Island. The detailed instructions for the British expedition are yet to be drawn up, but the general orders are in the main those with which Sir James Ross sailed. He was "to notice in the S. Atlantic the point where he crossed the curve or line of least magnetic intensity; to ascertain the depth of the ocean whenever practicable, and the temperature and specific gravity of the water at different distances below the surface; the strength and direction of currents and tides; periodical movement of the barometer; comparative brightness of stars; refraction; and to swing pendulums in special localities whereby to prove the figure of the earth. After refitting at Van Diemen's Land he was to proceed direct to the southward in order to determine the position of the magnetic pole, and even to attain to it if possible, which it is hoped will be one of the remarkable and creditable results of the expedition, one calculated to engross the attention of the scientific men of Europe."

The programme is a good one, even to-day, and needs little modification, except in so far as may be necessary to solve peculiar features of the Antarctic which have been brought to our notice by the researches of Sir James Ross and later expeditions.

MAGNETISM.

The primary object of the expedition is the completion and bringing up to date of the magnetic work done by Ross in the "Erebus" and "Terror," and by Moore and Clerk in the "Pagoda." Since that time no accurate survey of these regions has been attempted, and with

the ever-changing variation of the needle by unknown amounts, navigation by the compass much south of the Cape is somewhat precarious. The utility of doing this was recognised by the Government, for which purpose a grant of £45,000 was voted. Whilst at sea the magnetic elements will be determined each day by the standard compass, and an improved form of the Lloyd dip circle specially designed by Captain Creak, R.N., for observations at sea. The Fox circle will also be employed. Absolute measurements of the magnetic elements will be made whenever possible either on the ice or on land, and the relative instruments compared with them. For the land party recording magnetographs of the Eschenhagen type will be set up, a similar set of instruments being taken by the German expedition; thus indelible records of the variations will be obtained.

ATMOSPHERIC ELECTRICITY.

The observations for the quantity of electricity present in the atmosphere will be made by means of Lord Kelvin's portable electrometer, standardized at Kew with the large self-recording instrument there; the records will thus be comparable. In addition to this, Exner's portable electrometer will also be used.

AURORA AUSTRALIS.

The sympathetic disturbances of the magnetic needle with auroral phenomena has long been noticed, and therefore, as in the German expedition, special attention will be paid to magnetic observations when there is a display of Aurora Australis. In addition to this, measurements of its altitude will be made, its form carefully noted and photographed, if possible, together with spectroscopic observations, both visual and photographic. Photometric and polariscope observations will also be instituted. The relation of the Aurora Australis to that of the Aurora Borealis is of special importance in the connection between these terrestrial, electrical, and magnetic phenomena. Prof. Gyllenskiöld has shown that the folding of the Arctic Auroræ is always in the same direction, and from the results of the recent Iceland expedition, Prof. Scheiner has shown the undoubted coincidence of the negative pole spectrum of nitrogen with that of the aurora. It now remains to be seen whether the folding of the Aurora Australis is in the same direction, and whether it is the positive or negative pole spectrum that is coincident. The chief aurora line will be directly confronted with that most promising line given by the new gas Krypton, and for this purpose Prof. Ramsay has kindly presented the expedition with supplies of this rare element.

The frequency of Antarctic auroræ is as yet little known, for whilst the observers in the "Antarctic" and "Southern Cross" report bright and frequent displays, those in the "Belgica" state that the displays were feeble and infrequent. The explanation of this apparent discrepancy is probably that the two former ships were in the region of greatest auroral intensity.

GEODETIC OBSERVATIONS.

The equipment of the British expedition for geodetic and astronomical observations is in the main similar to that of the German expedition. For the determination of position the means employed will be in accordance with the situation and the accuracy required. At the shore base station a small transit instrument will be set up, and a portable altazimuth will be kept on board for accurate observations which it may be required to make on ice or at other landing places where the pendulums may be swung.

Two sets of $\frac{1}{2}$ seconds pendulums are already being swung at home base stations, first the Helmert type at Kew, and the Ellery type, loaned by the Victorian Government, at Melbourne; one of these sets will probably remain on the ship, and an observation be made at one or two places where it may be possible to set them up; the other set will be mounted and swung in the shore hut.

Gravity results in the Antarctic will be most valuable, for among the results of the Nansen expedition one of the most important is the considerable ocean depth found in the Arctic area. On the contrary it is supposed that the Antarctic glaciers rest on an uplifted continent, which in an exaggeration would give the figure of the earth the form of a top, and it has been suggested that whilst the flattening of the earth is $\frac{1}{2}\frac{1}{9}\frac{1}{3}$ in the northern hemisphere, the value $\frac{1}{2}\frac{1}{9}\frac{1}{7}$ will in probability more nearly represent the flattening of the polar diameter in the southern hemisphere. As the precession of the equinoxes and nutation are products of the earth's figure this result is interesting both to astronomers and geographers.

METEOROLOGY.

Regular meteorological observations will be made throughout the voyage, as well as at the land station, and in addition observations of the upper regions will be attempted by the aid of kites both on sea and land. Self-recording apparatus will be employed in the shape of barographs, thermographs, anemometers, sunshine recorders and hygrographs. Some work will also be done on clouds visually as well as photographically. Observations with Aitken's dust counter will also be attempted.

In the case of temperatures on shore, platinum thermometers connected electrically with the interior of the hut will be used, both embedded in the earth and ice if possible, with one also in the thermometer screen; by this means the necessity of leaving the hut to read the thermometers when the climatic conditions are dangerous will be avoided.

Should the expedition be able to reach McMurdo Bay for the establishment of the shore observatory, it is highly probable that the low-pressure belt girdling the Antarctic would be passed, and that the conditions would be more favourable for wintering if the anticyclonic area over the South Pole exists. At all events it was the east-south-east winds which caused an invariable rise in temperature as recorded at Cape Adare by the "Southern Cross" expedition.

OCEANOGRAPHY.

It is proposed not to carry on deep-sea observations on board the German ship to a greater depth than 1000 metres, but in this country it was thought advisable to go to much greater depths, and consequently the "Discovery" has been equipped for sounding and dredging to such depths as are likely to be met with. One of the things of first importance is to determine the origin and direction of movement of the great ice barrier, and everything that is feasible will be done to secure this. Soundings will of course be made as near as possible to its face, in order to determine whether or not it rests upon the bottom.

For the collection of specimens various drag and tow nets will be employed, and for the collection of samples of sea water (for the determination of its physical properties) in which such specimens exist, the Pettersson-Nansen insulating water-bottle will be used. On the voyage out some studies of phosphorescence may be made, and here the work of the physicist and biologist will be united. For the study of oceanic circulation observations will be made on the salinity of the water from various depths.

XUM

as well as upon the temperature determined by deep-sea thermometers. Observations of waves will also be attempted, the article for the Antarctic Manual on this subject being written by Captain Wilson-Barker, R.N.R., some of whose results on wave observations are given by Mr. Cornish in KNOWLEDGE for May (page 97).

Observations of the tides will be of extreme importance, for it is in the great southern ocean that the tidal systems of the earth have their birth, and here maybe the tidal effects are more approaching the state that would exist were the globe entirely covered with water. The prediction of tides by applying various factors for local conditions to the theoretical conditions of attraction is a problem of no mean order.

There are many other problems to be attacked, but it is beyond the scope of the expedition to do all that might be of interest. But among the many things that may be attempted if time and circumstances permit, is the study of the variation of carbonic acid in the atmosphere. Determinations of the amounts of this gas in the air of regions devoid of vegetation would be of high importance in testing Schloessing's theory of glaciation.

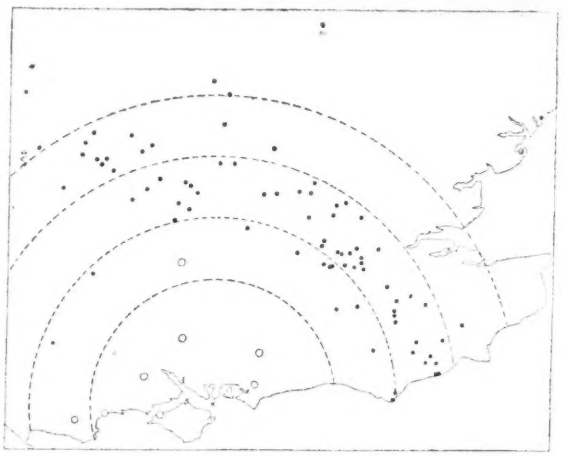
Another series of observations which might be made, should the expedition not return previously, are those in connection with the total eclipse of the sun, September 20, 1903. The maximum duration of totality is 2¼ minutes, and the central line, although starting in longitude 40° E. and latitude 46° S., does not touch land until it reaches the Antarctic area near the hypothetical Termination Is., it then passes over unexplored territory, and leaves the earth somewhat south of the volcanoes Erebus and Terror.

ON THE AUDIBILITY OF THE MINUTE-GUNS FIRED AT SPITHEAD ON FEBRUARY 1.

By CHARLES DAVISON, SC.D., F.G.S.

WHEN H.M.S. "Alberta" left Cowes on the afternoon of February 1 with the body of our late Queen, its course to Portsmouth lay to the south of a line of thirty men-of-war, ranging from third-class cruisers of about 2000 tons to first-class battle-ships of 14,900 tons. The ends of the line, indicated by crosses on the map, were occupied by the "Alexandra" on the west, and the "Majestic" on the east, the two ships being about eight miles apart. A shorter line, to the south of the other, was formed by the foreign ships of war and a group of torpedo-gunboats. As soon as the funeral procession left Cowes, about 3 p.m., a gun was fired from the "Alexandra," after which minute-guns were fired from the "Majestic," the other ships taking their time from the latter. Each ship stopped firing as the tail of the procession passed it, thus causing a gradual fading away in the intensity and duration of the reports. As the yachts rounded the "Majestic," the minute-guns were continued from the coast-defences and men-of-war in Portsmouth Harbour.* I am indebted to the Secretary of the Admiralty for the information that 6-inch guns were used with blank charges of 7 lbs. large grain powder. The guns, he adds, could not be fired simultaneously, but several were fired practically together, which would account for the reports occasionally sounding louder.

During the days succeeding the Funeral, many letters or abstracts of letters appeared in *Nature*, the *Times*, the *Daily News*, and especially in the *Standard*. The editors of the last two papers and of others published in the southern and midland counties kindly inserted requests from me for notes of observations. The total number of records from all sources at my disposal amounts to 97 from 84 places. These places are represented by dots on the accompanying sketch-map. There are also others, indicated by small circles, where, so far as known, not a single report was heard. The circular



arcs are drawn with the position of the "Majestic" as centre, and radii of 40, 60, 80, and 100 miles.

Most of the distant records of the minute-guns are unusually trustworthy, owing to the regularity of the discharges and the peculiar character of the reports. As a rule, a loud boom was heard, due to the nearly simultaneous discharge of several guns, followed by a rumble, lasting in some places for twenty seconds, as ship after ship along the line uttered the note of mourning.

From east to north-west, the places where the sounds were heard are scattered fairly uniformly between the 60 and 80-mile circles. Beyond the limit of the latter circle, they diminished rapidly in number, except in the neighbourhood of Cheltenham, where one newspaper editor, less sceptical than others, published my request for information. It should be mentioned that some of the most interesting accounts which appeared in the daily press were so far curtailed as to omit distinct reference to the minute-intervals; among this group being the records from Shelford (near Cambridge, 111 miles from the "Majestic"), St. Ives (Hunts., 118 miles), and Holme (near Peterborough, 125 miles). But there can be no doubt in this respect as to the observations from Northleach (82 miles), Kingham (near Chipping Norton, 84 miles), Egginton (near Leighton Buzzard, 84 miles), Moreton-in-Marsh (90 miles), Bishop's Cleeve (near Cheltenham, 93 miles), Alderton (near Winchcombe, Glos., 95 miles), and Alderton (near Woodbridge, Suffolk, 139 miles).

At several places the vibrations were occasionally strong enough to make windows shake. This occurred at Lingfield (56 miles), Sutton (58 miles), Wallington (58 miles) and Richmond Hill (61 miles), in Surrey; at Tunbridge Wells (65 miles) and Hayes (66 miles) in Kent; at Ashford (55 miles) and Pinner (67 miles) in Middlesex; and at Great Missenden (69 miles) and Ludgershall (77 miles) in Buckinghamshire.

While the sound-waves were thus heard at great distances, it is remarkable that in the immediate neighbourhood of Spithead they were almost or quite inaudible. The nearest place to the "Majestic" from

* Most of the above details are taken from the admirable account which appeared in the *Times* for February 2nd.

which I received any record is Horley in Surrey, distant 50 miles. It does not of course follow that reports were never heard at a less distance, for most persons so situated would imagine their observations to be of little consequence, but the undoubted fact remains that many who went out to listen to the guns returned home disappointed. Thus, one correspondent, who was on a steamer just outside the line of battle-ships, could hear only the reports from the vessel nearest to him. At Portsmouth, the first signal that the procession was approaching the harbour came from a gun fired from the "Victory," which is stationed there; for even the sound of the guns on the coast defences were scarcely audible in the town. It is said that not a report was heard at Chichester (15 miles from the nearest battleship), Midhurst (22 miles), Winchester (20 miles),† Fritham Plain (2 miles N.W. of Lyndhurst, 16 miles), Newbury (44 miles), Bournemouth (27 miles), and Yarmouth (I.W., only 10 miles).

There can be little doubt, I think, that the varying direction of the wind over the southern half of England is mainly responsible for this curious result. If there were no wind, and the temperature were uniform, the sound-waves from any gun would be spherical and the sound-rays rectilinear. If the velocity of the wind were uniform throughout, this would also be the case, though the sound would be heard slightly further in the direction towards which the wind is proceeding than in the other. But if, as usually happens, the velocity of the wind increases with the height above the ground, the sound-rays are no longer rectilinear. Those travelling in the direction from which the wind is coming are bent upwards, while those travelling in the same direction are bent downwards. In the former case, the sound-rays pass over the heads of observers at a moderate distance; in the latter, rays which started upwards at a small angle are brought down again to observers at a considerable distance. They are thus audible at much greater distances than if there were no wind, and besides travel as a rule along unobstructed paths.

Now, on February 1, the wind at places to the west of Spithead was generally light and from the west or nearly so, though near Lyndhurst there was a fresh breeze from about W.N.W. or N.W. At Portsmouth, again, the wind is described as from the shore. On the other hand, many of my correspondents at great distances from Spithead state that the wind, when sensible, was southerly in direction. Thus, the sound-rays were first of all refracted by contrary winds over the heads of observers between 10 and 45 miles, and were afterwards brought down again by favourable upper currents, so that the reports were clearly audible beyond 50 miles and up to 140 miles from Spithead, and were so loud at a distance of 84 miles that labourers in the fields put down their spades and listened.

FLOWERING PLANTS,

AS ILLUSTRATED BY BRITISH WILD-FLOWERS.

By R. LLOYD PRAEGER, B.A.

III.—FLOWERS.

HAVING briefly considered the uses and the architecture of the roots, stems, and leaves of plants, we now come to examine the floral structures. Here we find an elaboration of design, a wealth and variety of shape and colour, a specializing of organs to meet peculiar requirements, which must strike with admiration the most casual observer. The roots and leaves which we have been considering have for their main object the contributing to the success in life of the individual, and only indirectly, according as they minister to the life and health of the individual, do they in most cases contribute to the continuance of the race. Flowers, on the other hand, are especially concerned with the life of the race, not of the individual. If we cut off every blossom of a plant before it reaches maturity, the health of the plant will be in nowise injured; but seed will not be produced, and carried to its ultimate limit, such practice would eventually lead to the extinction of the species. We now begin to see why plants (so to speak) indulge in such an elaborate expenditure of care and ingenuity in the designing of their flowers—the hope of future generations rests in these delicate and marvellously beautiful structures, and on their success in carrying out their appointed part in the production of copious and perfect seed.

For our present purpose, the essential nature of a flower may be broadly defined in a very few words. A flower is a group of modified leaves, of which the essential parts consist of male and female elements, the male element consisting of pollen-producing organs, while the female consists of the young seed and its accompanying structures. The male organs, or *stamen*, at the proper time liberate grains of pollen, which on reaching the receptive surface of the female organs, grow down into the embryo, or young seed, and the union of these elements is followed eventually by the production of perfect seed. Surrounding these essential organs there are generally other leaves, of very varied shape, size, colour, and number—the sepals and petals. The function of these is largely protective, and often attractive; sometimes, as we shall see, repellant; and it is to these protean outer portions of flowers that our attention will be mainly directed. Now, although a large proportion of flowering plants produce male and female organs in the same flower, it is generally essential for the production of fertile seed that each flower should be fertilized, not with its own pollen, but with the pollen of another flower—that *cross-fertilization* should be effected. This implies the transfer of pollen from one blossom to another: and in the manner in which this transfer is effected we have the key to the mystery of the infinite variety of shape and colour that we find in flowers.

To begin with a simple case. The flowers of grasses consist each of several small chaffy green leaves, which enclose the male and female organs. The flowers are usually arranged in little groups, each group forming part of a large branched colony of flowers, or inflorescence; each individual flower is small and inconspicuous. The function of the outer parts of the flower is purely protective; they keep the essential portions warm and dry, and safe from the attacks of animal enemies. While the outer portions are thus minute in size, the essential portions—the stamens, and the receptive portion of the female organ, or *stigma*—are well developed and comparatively conspicuous, and project, when the flower is mature, far out into the air. Why is this? The grasses rely on the wind to carry the pollen from one flower to another. The stamens are large and long, that plenty of pollen may be launched on its journey free from surrounding obstacles. The stigma likewise projects, that it may have the better chance of intercepting the floating grains. In such flowers an abundant supply of pollen and projecting anthers (as the pollen-bearing portions of the stamen are called) and stigmas are the most serviceable modifications; and these requirements we find

† Winchester lies in a hollow; and, at other times, guns are, I am informed, often heard upon the Downs while they are inaudible in the city.

amply supplied in all such anemophilous or wind-fertilized flowers.

This plan of wind-fertilization, however, which was, no doubt, that employed by all the primitive flowering plants, and is still used by a very large number of them, possesses disadvantages which are sufficiently conspicuous. There is an enormous waste of pollen, because even under favourable conditions, for one grain which reaches the stigma of another flower of the same species, perhaps a hundred, perhaps a thousand, perhaps ten thousand, find other resting-places; and in inclement weather the waste of pollen must be prodigious. It is quite clear, therefore, that a great advantage would be gained could some means be devised for the direct and more certain conveyance of pollen from flower to flower; and this medium of communication is supplied by certain insect visitors. The attraction that led the insects to the flowers in the first place was no doubt this same pollen which they used, and which many still use, as food.

Wind-fertilized plants (Reed-mace, *Typha latifolia*, and Reed Meadow-grass, *Glyceria aquatica*). Very numerous inconspicuous flowers, of minute size, and devoid of coloured envelopes.
Photograph by R. WELCH.

The excessive consumption of pollen, however, might readily prove a source of injury which would more than balance the gain derived from the insect-traffic. It became, necessary, therefore, to provide a counter-attraction, which would induce the insects to continue and to multiply their visits, without the destruction of so much pollen. Sugar, in the shape of honey, was selected as a convenient and attractive offering to the insects, and in a large number of insect-visited flowers organs were developed whose special function was the providing of honey for the visitors. Thus equipped with a tempting stock-in-trade, the next duty was to advertise it. In this connection is it that flowers have undergone their most striking transformations. The insects' senses both of sight and smell were appealed to. The outer whorls of the flower, whose functions had been formerly chiefly protective, were enlarged and coloured, till they became highly conspicuous; and scent was produced, of various sorts, according to the kind of insect visitor which it was intended to attract; and by degrees a very high degree of specialization has been attained. Let us take a few instances. In our common Buttercups the outermost whorl of flower-leaves, or *calyx*, is green, not very large, tough, and hairy. It safely encloses the whole blossom till the latter is ready to burst open, keeps it warm and dry, and provides a defensive armour against nibbling insects. When the blossom expands, the calyx in some species falls off, its duty completed; in other species it remains. The next whorl, or *corolla*, is composed of brilliant yellow petals of considerable size and wonderful lustre, which render the flower in the highest degree conspicuous. These petals have a protective as well as an attractive function, for at night, or in rainy weather, they close like a hood over the inner essential portions of the flower, and protect them from cold and wet, opening again as soon as sunlight comes, and insects are on the wing. The numerous pollen-bearing organs, or stamens, are arranged in a ring inside the corolla, and in their turn surround the female organs, which, in the form of numerous separate *carpels*, are set on a kind of cushion in the centre of the flower. An insect visiting such a flower alights inside the cup-shaped corolla, and as it turns about in search for honey (which is secreted near the base of the petals and stamens) it rubs the under-surface of its body against the upper receptive portion of the carpels, depositing thereon some of the pollen which it has presumably picked up in visiting another flower previously, at the same time dusting itself with the pollen of the flower which it is now engaged in plundering. This general description will apply with slight modifications to a large number of our wild-flowers and their mode of fertilization—for instance, to our Stitchworts, and Wild Roses, and St. John's-worts, and the many Umbelliferous plants, but it will be seen that even in these flowers there is a considerable waste of pollen and honey. Both lie open to all comers. The honey may be stolen by small insects which do not fly from flower to flower, but have crawled up the stem, or by others whose minute size allows them to get at the honey without disturbing or touching the anthers or stigmas. And, again, both pollen and honey lie exposed to the weather. In *irregular* flowers, such as the Peas and Vetches, Snapdragons, Deadnettles, and Orchids, we find a much more specialized flower-structure. The flowers, instead of being cup-shaped, with their entrance vertical, are of various peculiar shapes, and have their entrances horizontal. Examine the blossom of the common Gorse. One large showy petal extends horizontally across the top of the flower, forming a protective roof. Two smaller ones stand vertically one on each side below this. The remaining two petals form the bottom of the flower, and are joined by their lower edge so as to form a boat-shaped structure. The group of long curved stamens and pistil lie along the bottom of this *keel*. The pollen is shed, in part at least, before the flower attains maturity, and falls into the bottom of the keel. A suitable insect, say a bee, visiting the flower, is bound, owing to its peculiar shape, to alight on the keel. Its weight, by depressing the keel, causes the tip of the stigma to slide out beyond the end of the keel, pushing before it some of the fallen pollen, and both come in contact with the under side of the bee's body. It is clear how much more certain and economical this device is than the lavish scattering of pollen carried on by the Buttercup. And here we notice a discrimina-

tion on the plant's part between suitable and unsuitable insects: a feature which becomes remarkably developed in many of the more highly specialized flowers. They cannot afford to give honey and to dust pollen on every visitor; and along with arrangements made to suit welcome insects may be found an equally elaborate series of precautions against the visits of insects which do not assist fertilization. Crawling animals constitute a large proportion of these unwelcome guests, for in the tedious journey down the stem, perhaps across rough ground, and up a neighbouring stem, whatever pollen had adhered to the body, say of an ant, would inevitably be wiped off before the insect reached another flower. Such useless visitors are kept away from flowers by various devices—by palisades of downward-pointing bristles, and entanglements of hairs or down, on the stems or on the calyx; by quagmires of gummy excretion; sometimes even by means of a moat full of water, as in the case of the Teasel. How effective these barriers are a little observation will show. Prof. Kerner counted small animals of sixty different kinds—beetles, flies, ants, bugs, ichneumons—trapped by the sticky stems of *Silene nutans* in the Tirol; and the viscid hairy stem and calyx of a Moss-rose must prove a practically impassable barrier to would-be explorers. Often the protective appliances are found in the blossom themselves, and this brings us back to some of the irregular flowers which we were considering. The Snapdragons and Toadflaxes exhibit a simple and complete method of protection from small prowlers. The flower is shaped like a mouth, with two closed lips; the pollen and honey are in the interior cavity. It is only an insect which is strong enough to force open the lips, or whose weight, depending from the lower lip, is sufficient to depress it, which can reach the interior of the flower. In other cases the stamens form a ring which must be pushed aside before the honey is reached. The encouragement of useful insects and the discouragement of useless ones, go hand in hand.

The Salvias furnish a pretty case of exact adjustment for their insect visitors. The flowers are exceedingly irregular, the upper part of the corolla forming a high arch over the flower, the lower part forming a broad landing-place for the insects. The corolla is prolonged downwards into a narrow tube, at the extremity of which is the honey-well. The stamens and *style*, as the stalk of the stigma is called, curve along the arched roof of the flower, above the entrance. The stamens are hinged near the end, the free portion being prolonged downwards, and hanging in the entrance. When an insect alights on the platform, and inserts its head into the flower in order to draw honey from the well, it pushes the end of the hinged portion of the stamens inward and upward, with the result that the opposite end, which bears the pollen, swings downward and strikes the hind portion of the insect's back. And there is a further point. It has already been noted that most flowers, in order to produce perfect seed, should be fertilized not with their own pollen, but with the pollen of another flower of the same species. In the Salvias the stamens are ripe and shed their pollen before the stigma is in a receptive condition, and in this way (as in a great many other flowers) self-fertilization is avoided. But the style continues to grow, and by the time the stigma is mature it has outgrown the stamens, and occupies exactly the position which the stamens occupied on striking the insect's back. So that our insect, on visiting a slightly older flower, brushes the stigma with precisely that portion of its back on which the pollen was deposited. It is to be noted that a small insect, visiting this flower, would not touch the stamens or stigma, under which it would walk to the honey-well, which it would find too narrow to allow of its entrance, and too deep to be sounded by its short proboscis. It would go away, having disturbed neither the pollen nor the honey.

It is in the Orchid tribe that specialization of this kind has been carried furthest, and in these plants we

Insect-fertilized flowers, showing conspicuous effect produced (1) by great enlargement of the corolla (*Convolvulus*), and (2) by the grouping in a large umbel of numerous smaller flowers (*Angelica*).
Photograph by R. WELCH.

find an ingenuity of design, and a wealth and variety of form and colour, that are unequalled in the vegetable kingdom. Some of the common Orchids of our meadows will exemplify their structure quite as well as the most gorgeous Brazilian species. Examine one of our common British Orchids, such as *Orchis maculata* or *Habenaria bifolia*—they are just coming into bloom now. The calyx consists of three sepals, the corolla of three petals; all are coloured similarly, but differ in shape. It must be pointed out that these flowers, when mature, are all upside-down, as we may see by opening a bud, and comparing the relative positions of the parts with those of an open flower. This inversion of the flower is caused by a twisting of the ovary, or seed-vessel, which is long, and looks like the stem of the flower: this twisting also we may observe by comparing the ovaries of a bud and of an open blossom. The large petal which, in the bud, is topmost, and folds over the other portions of the flower, in the open blossom is lowest, and forms a broad landing-stage. Two sepals stand one on either side; two petals and the remaining sepal form the roof of the flower. The lowest petal is prolonged backwards

into a deep narrow honey-well. So far the flower resembles in many respects that of the Salvias described above. But when we look for the stamens and pistil we find an extraordinary structure. The pollen-grains are fastened together into two oblong bundles by means of slender threads, and each bundle is prolonged into a delicate stalk, the tip of which is enlarged and coated with viscous fluid. The whole is embedded in the wall of the flower, over the honey-well, and facing the entrance, and the sticky termination of the stalk alone is exposed. The stigma is likewise embedded, and shows a sticky surface below the position of the stamen. How does this structure work? A bee alights on the platform and pushes its head into the entrance to the tube. Its forehead comes in contact with the sticky extremities of the embedded pollen-masses, and on withdrawing, it pulls one or both of these out of the grooves in which they rest: the bee flies off with the pollen-masses sticking on its forehead like two horns. And now a remarkable thing happens. Owing to unequal shrinkage caused by drying, the stem of each pollen-mass curves, so that instead of standing upright they now project forwards. In consequence, when the bee visits another flower, and inserts its head, the pollen-masses come in contact, not with that part of the flower which encloses the pollen, but with the sticky stigmatic surface below, and thus fertilization is effected. The absolute accuracy of the method, the economy of pollen, the way in which the plant is entirely dependent on the visits of the right kind of insect for its fertilization, show that here we have reached the very acme of specialization in this direction. It is to be noted that along with the modification of the plants to suit insect-visitors, considerable modification in the structure of the insects has taken place to suit their honey-sipping habits, so that now many are as dependent on the flowers for their food, as the flowers are dependent on insects for their fertilization. There is a complete symbiotic interlocking between the representatives of the animal and vegetable kingdoms.

It is the most highly organized plants that lay themselves out to attract the most highly organized insects. Simply-constructed flowers like the Buttercups and Umbellifers, which have their honey and pollen openly exposed, are visited by a motley crowd of flies, beetles, ants, and other insects, and these flowers are largely yellow or white in colour. With more specialized flowers come preventive measures, and the encouragement of certain groups of winged insects; while the most highly developed flowers lay themselves out exclusively for the attentions of the aristocracy of the insect world—the bees, butterflies, and moths; and from the simple yellows and whites of the lower flowers they turn to the richer tones of red, and purple, and blue.

CONSTELLATION STUDIES.

By E. WALTER MAUNDER, F.R.A.S.

VI.—THE SWAN AND THE EAGLE.

ONE feature of the primitive constellations, whatever its significance, cannot escape the most casual notice. Many of the forms, indeed most of them, are duplicated, and when thus repeated the twin symbols are, as a rule, not widely separated, but placed close together. The portion of the sky to which we have now come is the home of the birds. Here, Aratus tells us,

> "There is in front another Arrow cast
> Without a bow; and by it flies the Bird
> Nearer the north. And nigh a second sails
> Lesser in size, but dangerous to come
> From ocean when night flies; the Eagle named."

In the midnights of early June, the great stream of the Milky Way crosses the sky from due south to due north, not passing, however, through the zenith but somewhat to the east of it. Right in the centre of this magnificent arch, forming its very keystone, is the constellation of the Swan, easily found from its neighbourhood to Vega, Alpha Lyrae. The figure of the "Bird," or as we now know it, the "Swan," may be easily traced out. A long undulating line of bright stars lies parallel to the axis of the Milky Way, skirting the western edge of the great channel which here divides it. This represents the outstretched neck, body, and tail of the flying Swan. Crossing it at right angles, is another undulating line of stars which represents the outstretched wings of the flying bird. The whole constellation has often been termed from its shape the "Northern Cross." Beta Cygni marks the extreme tip of the Swan's bill, and lies about as far beyond Gamma Lyrae as Gamma is from Vega. Its name is usually given as Albireo, but the meaning and derivation of the word is obscure, and is almost certainly due to a mistake. The Arabic name is Al minkar al dajajah, the "Hen's Beak." It is one of the loveliest double stars in the entire heavens; the principal star, of the third magnitude, being topaz yellow, the companion, of the seventh magnitude, sapphire blue, and the distance, 35″, being within the power of a field-glass.

Gamma, the bright star which marks the intersection of the cross, is the centre of a most interesting region. The whole extent of sky from Beta to Gamma is perhaps the richest in the entire heavens, and Gamma itself is in the midst of rich streams of small stars, interspersed with some strikingly definite dark lanes. Of the transverse beam of the cross, Epsilon marks the eastern arm, Delta the western, and from Gamma to Epsilon we find one of the most remarkable gaps in the Milky Way, the "Coal Sack." Alpha has been called Deneb Adige, the "Hen's Tail," or Aridif, the "hindmost" or "follower," both titles appropriate enough to its place. The entire region of the constellation is full of interest and beauty, whatever the optical power with which it is examined, from the naked eye up to the greatest telescope. One of the many interesting objects in the region is Omicron. To the eye a double star makes a trapezium with Alpha, Gamma and Delta; the brighter of the members of this double, Omicron, in the field-glass will be seen to have two companions, one on each side, both of them blue, whilst the chief star is orange.

Aratus gives the constellation simply as the "Bird," without naming its species, but Eratosthenes defines it as the "Swan," and its length of neck well agrees with the identification. Dr. Lamb's somewhat doggerel rendering of Aratus enlarges upon his author in this connection to bring in absolutely without warrant the story of Leda and Zeus. The second bird is, however, plainly identified as the Eagle, and its chief star, Altair, forms the third point of a roughly equilateral triangle, the other two angles of which are marked by Vega and Alpha Ophiuchi. It is also easily identified by the two smaller stars, Gamma and Beta, above and below it; these making with it a characteristic figure of three bright stars in a straight line, on the borders of the Milky Way. The three stars bear the following names:—The middle one, Alpha, is Altair the "Bird," that is the "Flyer"; the "Soaring Eagle," as contrasted with Vega, the "Swooping" or "Falling Eagle"; the southern star is Beta, Alshain, the "White

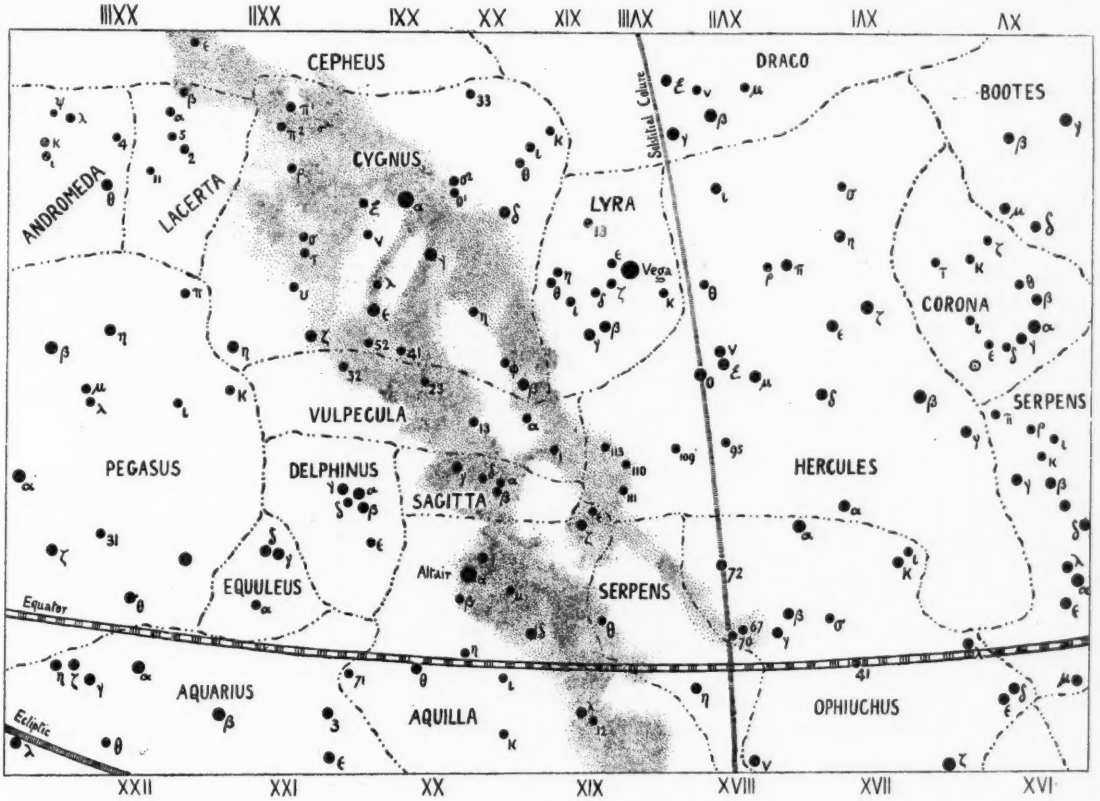
Falcon"; and Gamma, the northern star, Tarazed the "Robbing one."

The rest of the constellation can be made out without much trouble, but the figure is by no means so good as that of Cygnus. Two stars, Zeta and Epsilon, near together, mark the tip of one wing in the north-westerly direction, and a very much fainter pair, 70 and 71, mark the tip of the other wing, about the same distance on the other side of Altair. Proceeding from Gamma down the Milky Way, we find Mu, Delta and Lambda, reproducing roughly the arrangement of stars which to that in which he is shooting. This is the explanation of the phrase—

"Another Arrow cast
Without a bow;"

nor can either of the three heroes, who are near at hand, the Herdsman, the Serpent-holder, or the Kneeler have despatched it. The Herdsman grips his crook, the Serpent-holder has both hands full of the twining snake, and if we accept the guess of Panyasis that the Kneeler was really Hercules, Germanicus tells us that one hand held a club, the other a lion's skin.

Parallel to the Arrow, and of not much larger extent,

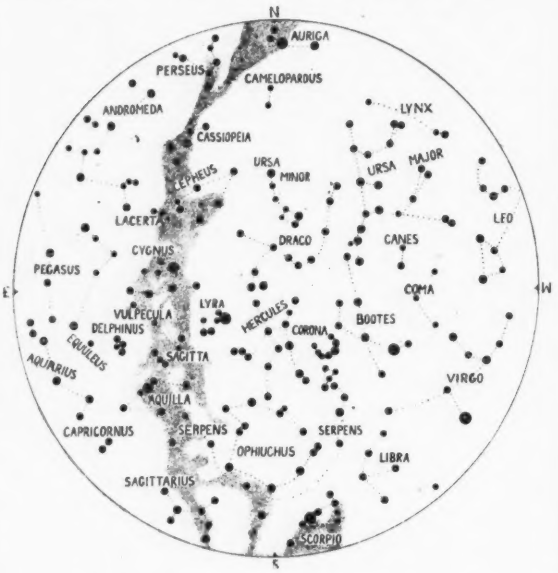


Star Map No. 6; The Region of Cygnus.

marks so clearly the neck and head of the Swan. Following the line of the three stars, Alpha, Beta, Gamma, we find they point downwards to a bright star, Theta; between this and Delta, but nearer to Theta, is Eta, one of the regular variable stars of short period, visible in all its phases to the naked eye, its period being one of four hours over the week.

The quotation from Aratus at the head of this paper refers to a little constellation which in a certain sense is the most interesting in the entire sky, the constellation of the Arrow. Possessing only five little stars of the fourth magnitude, and extending in a narrow line, but 4° in length, increased by the moderns to 10°, it is nevertheless one of the oldest constellations, being mentioned three times by Aratus in his celebrated poem, and having its five principal stars duly catalogued by Ptolemy. The history of the Arrow was lost even in the time of Aratus. It was not shot by Sagittarius the Archer; so much is quite clear, for it is flying high above his head and in the opposite direction is the modern constellation, Vulpecula, framed by Hevelius in 1690. Its principal interest to the naked-eye observer is the meteor stream which radiates from it in the latter half of June, and to the telescopic observer the celebrated Dumb Bell nebula, just visible in the field-glass. A line from Alpha Ophiuchi through Zeta Aquilae, and another from Alpha Cygni through Epsilon Cygni, will meet together in a pretty little constellation, which, once picked out, can never be forgotten, its leading stars being so nearly equal in magnitude and so close together. This is the constellation of the Dolphin, containing ten stars in Ptolemy's catalogue. Two of these are a little brighter than the fourth magnitude, and seven others range from that down to the fifth. Alpha, Beta, Gamma and Delta form a compact little lozenge, the straight line of Gamma and Delta being continued on by Zeta and Epsilon. Though the Dolphin is one of the ancient constellations, the names attached to the two principal stars are quite modern, and are due to a piece of very clumsy humour

on the part of Piazzi, the Sicilian astronomer. In his catalogue he introduced for these two stars the names



The Midnight Sky for London, 1901, June 2.

Rotanev and Svalocin, names which gave a good bit of trouble to etymologists until it was seen that they were simply the name of Piazzi's assistant Niccolo Cacciatore, latinized and spelt backwards.

NEW STARS.

By the Rev. A. L. CORTIE, S.J., F.R.A.S.

THE appearance of the brilliant star in the constellation Perseus, discovered by the Reverend Dr. Anderson, of Edinburgh, in the early morning of February 22nd, has naturally awakened the keen interest of astronomers in the subject of the origin and composition of such bodies. In the twenty centuries that elapsed between the years B.C. 134 and A.D. 1892, when the last new star visible to the naked eye, previous to the advent of the present stranger, was also discovered by Dr. Anderson, only nineteen cases of such appearances have been recorded. Another six, of small magnitude and invisible to the unaided eye, appeared on the photographic plates secured in the period 1877 to 1899 by the indefatigable director of the Harvard College Observatory, Professor E. C. Pickering. Of the first new star known to us by historical records, we learn the bare fact that its discovery was due to Hipparchus, and the interesting statement of Pliny that it suggested to the Greek astronomer the construction of a catalogue of stars, the earliest that is extant. Of the other new stars discovered before the general adoption of the spectroscope and photographic plate as powerful auxiliaries of the telescope, the most famous was Tycho Brahe's star, which blazed out in the constellation Cassiopeia in the year 1572, and was visible for a year and five months, rivalling at first Venus and then Jupiter in brilliancy. Of this star it is recorded that its colour changed from white through yellow to red, and then to white again, thus furnishing some indication of a probable fluctuation in and recuperation of its light, phenomena which have been also marked in succeeding new stars. Another Venus-like star was that observed by the famous Kepler in A.D. 1604, and visible for a year. The brilliancy of this star joined to a conjunction of the planets Jupiter, Mars, and Saturn in the same part of the heavens led the illustrious astronomer to propound the theory that it was a similar phenomenon which appeared to the wise men in the East and led them to Bethlehem. The same century witnessed yet another outburst, in the year 1670, this time near the star β Cygni, the detection of the star being due to the Carthusian monk Anthelmus. This star was visible for two years, and likewise exhibited fluctuations in its light. The century just completed was marked by five such apparitions, namely: in 1848, when a star was discovered by Dr. Hind in the constellation Ophiuchus; in 1866, when a star in the Northern Crown blazed up suddenly from the ninth to the fourth magnitude, and after again increasing its lustre six-fold in about six hours, finally became a variable; in 1876, when a star of an orange-red tint appeared in the constellation Cygnus, which attained a lustre equal to that of a third magnitude star, and which when observed by Burnham at the Lick Observatory in 1891 was a small star of 13.5 magnitude, and "at times seemed to resemble an exceedingly minute nebula"; in 1885, when a star appeared in the very heart of the Andromeda Nebula; and finally in 1892, when Nova Aurigæ was discovered. On the appearances presented by this star it will be necessary to dwell somewhat in detail, as it marked a considerable advance in our knowledge of the varying phenomena of such temporary visitants. It was certainly not of the eleventh magnitude on December 8th, 1891, otherwise it would have impressed its image on the photographic plates of that portion of the sky taken by Dr. Max Wolf of Heidelberg. Two days later it was on the plates taken at Harvard College, and was of the fifth magnitude. It attained its first maximum of 4.4 magnitude on December 20th. It then decreased slowly in brightness with slight fluctuations until January 20th, 1892, when it was somewhat below the fifth magnitude. It was first seen, and discovered by Dr. Anderson, for its prior history by means of the photographs was only elucidated subsequently to his announcement, as a fifth magnitude star on January 24. After this it received another access of lustre and attained a second maximum of between the third and fourth magnitude on February 3rd. It then steadily grew fainter, with the exception of another slight rise in magnitude between March 16-19, until at the beginning of April it was equal to a faint thirteenth magnitude star. On April 24th the Lick observers estimated its magnitude as sixteen. But in August of the same year, it again recuperated its energies, rising to the ninth magnitude, or increasing in brightness nine hundred fold.

There occurred, therefore, in this star a sudden outburst, a rapid rise to brilliancy, a fall, another rise to maximum brightness, again a fall, a third rise, though less brilliant than its predecessors, and then a rapid and persistent fall to extreme faintness. But four months after, it became an easily discernible telescopic object, its haziness of outline suggesting that it too had become a nebula.

With regard to the nova of the present year, although the observations have not yet been completed, we notice a similar sudden burst from a low to a high magnitude, at least 12½ magnitudes in three days, corresponding to a 100,000 fold increase in its light, a similar gradual decline with fluctuations of brilliancy, so that at the end of March the star seemed to have become a variable with a period of three days.

The nova of 1866 was the first new star the light of

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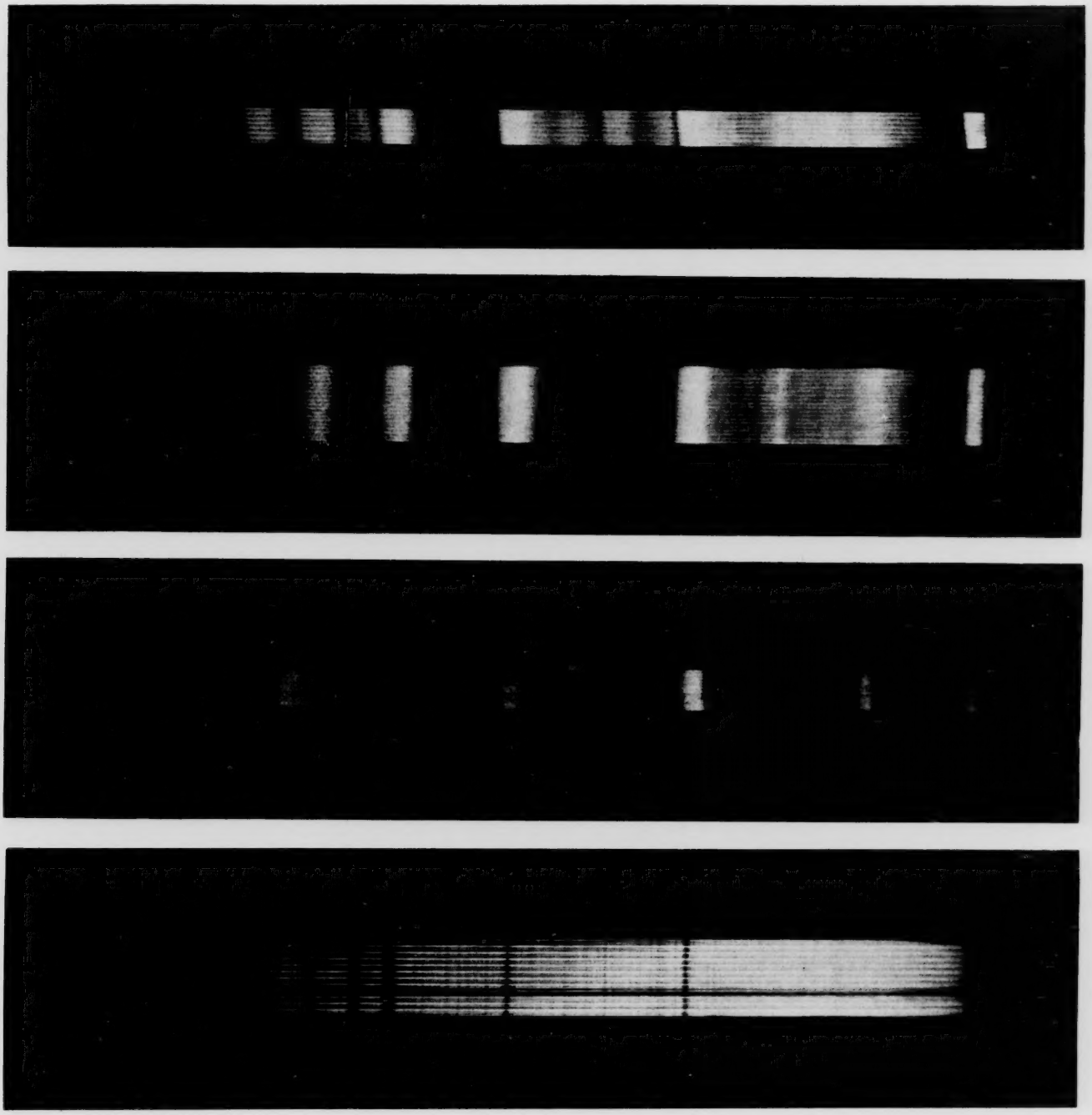

PHOTOGRAPHS OF THE SPECTRA OF NOVA PERSEI AND PROCYON.

STONYHURST COLLEGE OBSERVATORY.

1.—1901, March 3rd, 8 p.m. 2.—March 21st, 8½ p.m. 3.—March 25th, 8½ p.m.

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which was subjected to the analysis of the spectroscope, the earliest observations being those of Sir William Huggins and Dr. Miller. The chief facts observed with regard to its spectrum were that it was compound, being composed of two series of bright and dark lines, superposed upon a background of continuous spectrum, and that the bright hydrogen lines predominated. M. Cornu called attention to the matching of the brightest lines in the star's spectrum by well-known lines seen bright in the chromosphere of the sun. With regard to the spectrum of Nova Cygni in 1876, Professor Vogel called attention to the extent of the spectrum which stretched far into the violet regions, the double spectrum of bright and dark lines, especially those of hydrogen, and the gradual changes in the spectrum, which had become reduced to a single line in the green, very near in position to the chief line characteristic of nebulæ, when the star had fallen to the tenth magnitude. The spectrum of Nova Andromedæ in 1885 was mainly continuous, being similar in this respect to the spectrum of the first days of Nova Persei, and, moreover, confined to the green. The spectrum of Nova Aurigæ was the first which was permanently recorded for future comparison and study by means of the photographic plate. It was a very wonderful spectrum, with many new details of its own, but still confirming all the earlier observations of the spectra of novæ. The compound or double spectrum of bright and dark lines was very striking, the more intense bright lines, especially those of hydrogen, being accompanied on their more refrangible sides by broad dark companions. The line near the position of the chief nebular line was very marked. The spectrum, too, was of great length, extending from beyond C in the red right down to the further limit of the ultra-violet. It was full of lines, the Stonyhurst photographs, which comprised the region from D in the yellow to H in the violet, showing more than 200 lines. Many of these lines, too, were of great breadth, notably those of hydrogen, extending over several tenth-metres, or units of wave-length. On an average the centres of the dark absorption lines were about 11 such units removed from the most intense points of the bright bands. The match, too, both in character and position of the lines in the spectrum of the star, and in the spectrum of the sun's chromosphere was very evident. Moreover, sharp bright lines appeared on the dark bands after the star had attained its maximum. Such an appearance is not unknown in the spectrum of sun-spots, and on the calcium lines H and K, in the solar spectrum. Lastly, when the star received an accession of light in the August of 1892, the spectrum as examined by Professor Campbell, of the Lick Observatory, was strikingly similar to that of planetary nebulæ.

The beautiful photographs of Nova Persei by which we are enabled to illustrate this paper, through the kindness of Father Sidgreaves, were taken on March 3rd at 8 p.m., on March 21st at 8.30 p.m., and on March 25th also at 8.30 p.m., by means of an objective prism of about 4 inches aperture, made by Mr. Thorp, and fixed to the finder, also of the same aperture, made by Cooke & Co., of the 15-inch equatorial. A spectrum of Procyon is placed below the spectra of the nova to show the positions of the hydrogen lines or rather bands. Reading from right to left they are Hβ to Hϵ, the calcium line K, immediately following Hϵ. Without entering into any details these photographs sufficiently illustrate the chief points to which we have directed attention in the spectra of all novæ. There are many other matters worthy of study, but beyond the scope of the present paper. There is, however, one fact with regard to the changes in the spectrum noted in Nova Persei, which deserves mention, as it has never been observed before. It is that when the spectrum was photographed at Harvard, and observed at Edinburgh on the night of February 22nd, it was continuous and crossed by only thin dark lines. By February 24th the bright lines were well in evidence with their dark companions. This would seem to point to a sudden raising of the temperature of a dark solid cold body to a white heat. Then came absorption by the vapours thrown off, giving the dark line spectrum so well known in the sun and in the stars of the Orion type, and then the supremacy in radiative power of the gaseous spectrum suddenly asserted itself, and became the chief feature, as is the case in those storms on the sun which we call spots and prominences.

How then are we to account for the origin of such stars? At the outset we must frankly acknowledge that the appearances are extremely puzzling, and that so far no theory has been broached which satisfies all the conditions of the problem. For any theory of a new star's origin and constitution must needs find an explanation for the sudden outburst of light, for its fluctuations in intensity, for the complicated spectrum, its extent, its multitude of lines, the phenomena of the bright lines and their dark companions, together with their exceeding great breadth. But the crucial point of the whole problem lies in the fact that this shifting is always in the same direction, of great extent, and persists for a long time. I fancy any theories that purport to explain the appearances on the supposition of the motion either of meteors through a nebula, or of a cold dark body through luminous particles, must needs satisfy, first the enormous velocities of the moving bodies in the line of sight, some 500 miles a second at the least, if indeed the displacements observed are due to motion in the line of sight, the persistence of such velocities for months, and, most difficult point of all, their invariable occurrence exactly in our line of sight. Should we attribute the great widening of the lines to pressure, after the analogy of the laboratory experiments of Humphreys and Mohler, and of Wilsing, we do not escape the difficulty of the long persistence of such pressure, to say nothing of its enormous amount.

However, we note that the light curve of new stars is very like the curve of sun-spot frequency, with the rapid rise to maximum, and the fluctuations as the energies displayed in the initial stages of the outburst are gradually expended. Next the spectrum of new stars is in the main the spectrum of the solar chromosphere, at least in its earlier stages. Moreover, appearances very similar, though on a greatly reduced scale, to the double spectrum of new stars can be observed in the spectra of sun-spots and prominences. And it must be borne in mind that a sun-spot is only one of the forms in which the forces in the sun are displayed. For a sun-spot is always accompanied by prominences, as also by faculæ at times of vast extent. It is true that in the chromosphere the lines, except at their bases, are very thin, showing that the pressure cannot be very great; but in spots the lines are widened, due no doubt to the density of the matter composing them, and, moreover, frequently shifted, perhaps the partial result of pressure. We have already alluded to the reversals to be seen so frequently in the spectra of spots and prominences, and, moreover, bands have been observed in the spectra of the former. But in spite of all these similarities we cannot claim them as anything more than suggestive of the possible lines on which the problem as to the origin of new stars is to be attacked.

XUM

NOTES.

ASTRONOMICAL.—The observations of the total eclipse of the sun on May 18th appear to have been only partially successful. In Sumatra the conditions were very unfavourable, although not bad enough to completely obscure the sun. We gather that the Dutch astronomers succeeded in obtaining photographs both of the corona and spectra, but the prismatic camera did not succeed. At the time of writing there is little news from the British observers in Sumatra, but it has been reported that the duration of totality was six minutes twenty-one seconds. In Mauritius, where Mr. and Mrs. Maunder were stationed, the total phase appears to have been well observed. Fifty-two photographs of the corona and eighteen photographs of the spectrum were taken with the various instruments. The corona was of the expected minimum type.

Prof. Campbell has recently utilised the spectroscopic results obtained at the Lick Observatory for an investigation of the sun's motion in space. The conclusion is that the sun is approaching a point in R.A. 277° 30′, Decl. + 19° 58′, with a velocity of 19·89 kilometres per second. This velocity is considerably smaller than the average of the 280 stars on which the calculations are based, and Prof. Campbell further considers that there is evidence that the faint stars are moving more rapidly than the bright stars, and therefore that they are relatively further from us than the investigations of their proper motions have led us to conclude. Through the generosity of Mr. Mills, Prof. Campbell will be enabled to extend his researches so as to include stars invisible at Mount Hamilton by establishing an observatory in the Southern Hemisphere.

Mr. R. T. A. Innes, of the Cape Observatory, has communicated a paper to the Royal Astronomical Society in which he gives several instances of stars which have not disappeared instantaneously when occulted by the moon, some of them vanishing in two distinct stages, and others by "gliding." He points out that on several occasions double stars have been detected by the phenomena attending their occultations, and considers that disappearance either in two stages or by gliding is almost certainly due to the star being really a binary system. A particularly interesting feature of this mode of detecting double stars is that the observation can be made with telescopes of very moderate size. Mr. Innes remarks that many of the doubles which may in this way be discovered will be too close for telescopic confirmation, and may therefore form a class intermediate between visual doubles and spectroscopic binaries. Special interest attaches to the behaviour of known spectroscopic binaries, and it is suggested that careful observations should be made of the coming series of occultations of α Virginis.

In the course of a communication received from Baron Kaulbars, of St. Petersburg, it is suggested that the fluctuations in brightness of Nova Persei are due to a ring of meteors, of varying density, which surround the star. The idea seems to be that the light is dim when a dense portion of the ring is in front of the star, and bright when a sparse portion is in front. The arrangement appears to be a very artificial one, and it is difficult to understand how it can account for the changes of spectrum.

In Harvard *Circular* No. 58, Prof. Pickering discusses the interesting photometric problems suggested by the variability of Eros. Owing to the varying position of the observer with regard to the planet, it will be possible to gain much information which is inaccessible in the case of a variable star. The material already accumulated is under discussion, and the preliminary results will shortly be available for publication. In the photographs taken in 1893, 1894, and 1896 (before the existence of the planet was known), distinct changes can in some cases be traced in the brightness of different parts of the same trail. This suggests an easy method of discovering short period variability in an asteroid.—A. F.

BOTANICAL.—A curious instance of a root being transformed into a leaf, or, at least, into an organ which apparently possessed all the usual characters of a leaf, is recorded by Professor R. A. Philippi in a recent number of the *Berichte der deutschen botanischen Gesellschaft*. Professor Philippi planted in flower-pots a number of corms of *Crocus vernus*, which he had received shortly before from Holland. These failed to show any signs of growth above the soil, which was therefore turned out of the pots, when a white piece of root, 12 cm. long and 2 mm. thick, was found attached to a piece of a Crocus-corm. He inserted the corm-end of the root in soil to the depth of 4 cm., and allowed the rest to be exposed to the light. After several weeks, a slightly elevated line was observed on the side of the root which received the greatest amount of light, and this quickly developed into a green, leaf-like body, 7 mm. in width. The function of assimilation proceeded as in an ordinary leaf. New roots were formed, and subsequently four normal leaves.—S. A. S.

ENTOMOLOGICAL.—An interesting contribution to the life-history of beetles has been made by Mr. G. C. Champion and Dr. T. A. Chapman, who publish in the *Trans. Entom. Soc. London*, for 1901 (pp. 1-18, pls. 1-2), some observations on certain species of Orina, an Alpine genus of Leaf-beetles (Chrysomelidæ), adorned with brilliant metallic colours. The statement of former naturalists that most of these insects bring forth their grubs in an active state is confirmed; such "viviparity," unusual in insects generally, is especially rare among beetles. One of the observed species (*O. tristis*), however, lays eggs which are subsequently hatched. The most remarkable fact brought to light in this paper is that, in *O. vittigera* at least, the embryos develop not in the vagina but in the ovarian tubules. Evidently the method of fertilization in these beetles must be exceptional.

Father Wasmann describes (*Zeits. f. wiss. Zool.*, LXVII., 1900, pp. 599—617, pl. 33) some remarkable flies—Termitoxenia—found in the nests of South African termites ("white ants"). These flies have the hinder segments of the swollen abdomen doubled under, somewhat like the "tail" of a crab, and the thorax is provided with appendages (suggestive of vestigial wings) whereby the insects are lifted and carried about by their hosts. This observation renders it likely that the flies supply the termites with some food-product, despite the fact that the lancet-like structure of their jaws shows them to derive their own food from the bodies of the termite larvæ. They furnish, therefore, an interesting link between the parasitic and the inquiline habit.—G. H. C.

ZOOLOGICAL.—In a paper on the musk-oxen of Arctic America and Greenland, published in a recent issue of the *Bulletin* of the American Museum of Natural History, Dr.

J. A. Allen mentions that the first suggestion of the distinctness of the Greenland from the American form appeared in KNOWLEDGE, in the article on the young musk-ox at Woburn. It is true that the author of that article, misled by some badly-executed photographic reproductions, did not at that time realize the constancy of the distinctive features he pointed out as differentiating young Greenland musk-ox from the American representative of the species. But in his subsequent separation of the Greenland form, on account of its white face-markings, as a local race he has been fully justified by the American material. Indeed, on account of certain differences in the form of the horns and hoofs, Dr. Allen would go one step further, and consider the Greenland musk-ox entitled to rank as a separate species, under the name of *Ovibos wardi*.

In the April issue of the *Proceedings* of the Zoological Society of London are published extracts from a letter addressed to the Secretary by Sir Harry Johnston, relative to a hitherto unknown mammal of the approximate size of a horse inhabiting the Aruwimi, or Congo, Forest in the country between Lakes Albert and Albert Edward. The animal, which is known to the natives as the okapi, was described to Sir Harry as being iron-grey, or dun, above, with the legs and underparts striped, and the muzzle greatly elongated. Mention was made of two strips of skin, which in due course reached England, and were exhibited before the Zoological Society, when the animal to which they pertained was definitely stated to be a new species of zebra. On the 7th of April a coloured sketch of the okapi was exhibited to the Society on behalf of Sir Harry Johnston. This sketch shows a hornless ruminant with striped legs and uniformly coloured body. And it is suggested by Sir Harry that the new animal may prove to be a near relative of *Helladotherium* of the Grecian Tertiary. Be this as it may, the discovery promises to be one of the highest importance, and the description of the specimens reported to be on their way to this country will be awaited with interest.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

STELLAR PARALLAX.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—As is well known the moon, although it revolves round the earth, does not describe a circle in space but a curve of double curvature, because as it revolves round the earth, the earth travels along its orbit round the sun; but the sun is travelling at a rapid rate towards the star marked π in the constellation Hercules, consequently the earth does not trace an ellipse in space but a similar double curve. But we are taught at college that, when the earth's orbit is taken as base line, in estimating the parallax of distant fixed stars, the fixed star seems to revolve in a very small ellipse corresponding to the orbital base line described round the sun by the earth.

How is this, when the earth really describes in space a double curve, and how is the extra length of the base line through solar translation estimated in calculating the parallax of fixed stars? W. W. STRICKLAND.

[There is no difficulty in principle in distinguishing between the effect upon the apparent place of a star of the earth's motion every year in its orbit round the sun and the motion of the solar system in space. Thus, if we observe the place of a given star on the same date in several successive years, these places would be entirely unaffected by the annual parallax, and the "proper motion" of the star could be learnt from them. Observations at any other dates could be corrected for this "proper motion," leaving the effect of the parallax outstanding. The effects of precession, of the "sun's way" and of any actual motion in space which an individual star may itself have, are necessarily cumulative, and go on increasing from year to year; the effect of parallax is periodic, and runs through its changes in the course of a year.—E. WALTER MAUNDER.]

SUNSPOTS AND TERRESTRIAL TEMPERATURE.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—Will you kindly allow me space to assure Mr. Quensel that he is in error in attributing a connection between sunspots and terrestrial temperature. Your correspondent obviously cannot have read up the necessary series of meteorological observations for the past forty years, which refer to a large tract of the earth's surface. Mr. Quensel makes no mention of the places where the observations necessary for his deductions were made. Are we to infer that his remarks are applicable to the continents of Europe, Asia, Africa, America and Australia? Has he obtained a "mean" temperature from these continents, and then compared it with the sunspot curve? Certain it is that up to the present time *we have absolutely no evidence* that there is the ghost of a connection between the phenomena of sunspots and terrestrial temperature.

Louth, Lincs. G. MCKENZIE KNIGHT.

[Mr. Maunder has already pointed out that Mr. Quensel's statement could not be accepted without the figures on which it was based, and we think a similar remark would apply to the assertion made by Mr. Knight. The subject is a difficult one, and it is evident that much more analysis of the observations is required before any satisfactory conclusions can be drawn. It must be remembered that the variation of sunspots is only one of the indications of varying solar activity, and that sunspot phenomena alone, therefore, need not necessarily indicate the whole change of solar radiation.—EDS.]

CLOUDS ON MARS.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—Allow me to correct a mistake of mine made accidentally in my letter published in KNOWLEDGE for April. The word "dark" in the letter should have been "light." In the above letter I tried to call attention to the antagonistic views of Mr. Thomas R. Waring to those of other astronomers as to the visibility of clouds on Mars. As I understand Mr. Waring he states that the atmosphere of Mars is entirely free from clouds, and if so, I should be pleased to know his opinion as to the nature of the "light-coloured, moving spots" to which reference is made by Messrs. Wells and Gregory and other authors who might be quoted.

E. LLOYD JONES.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—In your April issue Mr. Lloyd Jones says that in a book by Mr. H. G. Wells and myself, "Honours Physiography" (1893), "it is stated that Mars possesses clouds which are visible in the large telescopes as dark moving patches." I have pointed out to Mr. Jones that no statement as to "dark" cloud markings is made in the book, and I should be glad if you would make this disclaimer known. What is said is that "Cloud-like

markings have been seen to obscure for a time the markings on the face of Mars." Mention is also made of Prof. W. H. Pickering's conclusion that "Clouds undoubtedly exist upon the planet, differing, however, in some respects from those upon the earth, chiefly as regards their density and whiteness." So far as I am aware, this is all that is said upon the subject in the book mentioned.

R. A. GREGORY.

Wandsworth, S.W.

Notices of Books.

"THE PRINCIPLES OF MAGNETISM AND ELECTRICITY." An Elementary Text-book. By P. L. Gray, B.SC. (Methuen.) 3s. 6d.—Several minor inaccuracies and laboured expressions have been allowed to remain in this book, otherwise we should have no hesitation in speaking of it in terms of unqualified praise. In the preface we read "The nomenclature of the science is largely derived from a period when unwarranted and probably erroneous ideas as to the nature of electricity were held," and this scientific attitude is maintained throughout, save in one or two notable instances. In speaking of magnets and magnetism, p. 1, Mr. Gray says:—"It was the discovery in some dim unknown former time," and three lines lower, "discovered at some unknown remote period." In a future edition the first two chapters should be re-written, for the remarks upon lines of force are not clear, and why should the student naturally assume the law of inverse squares to govern the strength of field at any point? Anyhow, the assumption is made; then, to our astonishment, we find on the next page, "We have also seen that it depends on the square of strengths." In Fig. 9 we see iron filings about the centre of the bar magnet. Chapter IV., dealing with the electric field, is good, but we are surprised at finding the coulomb defined as being 3×10^9 C.G.S. units. The coulomb is, of course, 10^{-1} absolute units of quantity. However, as someone remarked recently, it is absurd that we should have two units, one three thousand millions times as large as the other. A good description of the plate machine is given, but we note a slight inaccuracy in Fig. 38, the handle being wrongly placed. It would perhaps have been as well had the preliminary notions of potential, as also the water analogy, been introduced before this. The description and theory of the quadrant electrometer forms perhaps the best written portion of the book, but we are sorry to find that the author does not keep clearly before his readers that potential difference is not the same thing as electro-motive force. The remainder of the book is to be commended. We have, inter alia, chapters on Alternating Currents, The Discharge, Atmospheric Electricity, etc. The index is a very full one.

"WHAT IS HEAT? AND WHAT IS ELECTRICITY?" By Frederick Hovenden, F.L.S., F.G.S., F.R.M.S. (Chapman & Hall.) Illustrated. 6s.—The two conundrums on the title page of this book are but the precursors of a series with which the work is filled. Very little space is devoted to the giving of answers, and, we regret to say, that of the few answers given not all are accurate. "The solution," says our author, "of these two fundamental problems is placed in the hands of the physicists." From this he argues that the whole matter is treated by metaphysicians, since physicists use mathematics. Next, a heavy frontal attack is made upon the existing system of mathematics:—"All mathematical operations are functions of objects or actions"; "any number, per se, is meaningless." And later, "What is an object?" "Take a table." We must not, mathematically, according to Mr. Hovenden, speak of one table, because the table is made up of parts. The parts are of wood, and the wood contains cells made up of atoms. So the only possible unit is the atom. The mathematician, we are reminded, has no power to divide the atom, so, he has no right to speak of fractions. Having thus given the quietus to believers in simple arithmetic, it is naturally time that algebraic ideas should be abolished. "That part of space which has gained is +, and that part which has lost is −. Hence we obtain, as it were, a natural equation: $+1 = -1$." What is to be said of such reasoning? There is, however, worse to come, and, as the error led up to is one likely to be troublesome, it may not be out of place if we take it upon ourselves to answer Mr. Hovenden in detail on this one point. On p. 13, then, objection is raised to the algebraic law which makes the product −100 into −100 equal to + 10,000—(though, logically, Mr. Hovenden has no right to object, since he has but just enunciated his own "natural equation"). We read:—"See if we can realise this idea. We will take two bowls, and mark one A, and the other B. In the bowl A are 100 objects. We take the hundred objects out of the bowl A, and put them in bowl B. That is mathematically expressed, bowl A −100; B + 100. Now multiply the contents of bowl A (−100) by −100 times, and then, says the mathematician, there are ten thousand objects in that bowl!" It is upon such reasoning as this that our author strives in his next sentences to be sarcastic at the expense of the mathematician. But here are his mistakes. A contains a hundred marbles he tells us, these are removed to B. Therefore, A now contains 0 marbles (not −100 as he absurdly suggests). If he will now perform his operation negatively, 100 times over (that is, take 100 times 100 marbles from B to A), he will certainly find that A contains 10,000 marbles. But, so far, we have only arrived at p. 14, and here we propose to pause, for this reason—on p. 7 of his book Mr. Hovenden has asked "If the foundations are defective, how about the superstructure?"

"THE ELEMENTS OF THE DIFFERENTIAL AND INTEGRAL CALCULUS." By J. W. A. Young and C. E. Linebarger. Pp. xvii. and 410. (Hirschfeld Bros. 1900.) 10s. 6d. net.—The attention now being given to the calculus, in technical schools and other institutions where physical science and its applications occupy a prominent place in the curricula, is a noteworthy development of mathematical instruction. Attempts are sometimes made to show students who have insufficient mathematical knowledge how to apply the notions of the calculus, but the result must be unsatisfactory in the end, and generally leads to confusion. No student can obtain a really useful knowledge of the calculus unless he is prepared to devote a fair amount of time to the study of its principles. But if he will work steadily at acquiring this knowledge, he will find himself eventually in the possession of a most powerful machine, by which innumerable problems can be solved. The functions of the particular case are put into the machine, or the equation to the appropriate curve or surface is taken, and the result can be worked out almost mechanically. As most quantities in nature change or vary according to some continuous law, the differential calculus admits of applications of the widest range of subjects. Though this has, of course, long been recognised, yet the calculus has until recent years been taught and studied more from the point of view of pure mathematics than for its practical value. Now, however, several books are available in which the calculus is expounded "for engineers," "for technical students," "for chemists," and other students of science and technology. One of the first books prepared in this spirit was by Profs. Nernst and Schönflies, of Göttingen, and the present volume is an adaptation of it. The distinguishing characteristic is the continual use of illustrative examples from scientific data, and nothing but praise can be said for the introduction of this method. The German work was intended primarily for chemists, and a large number of the examples are drawn from physical chemistry. But as a matter of fact, there is very little that is specially chemical in this book, and although this shows that mathematical chemistry is still in a rudimentary stage, it also adds to the value of the volume to students who are not chemists. The book opens with a chapter on analytical geometry. As students beginning the study of the calculus do not possess usually the power of graphing even the simplest functions, this introduction is essential. After it the chapters deal successively and respectively with limits, fundamental conceptions of the differential calculus, derivatives of the simpler functions, fundamental conceptions of the integral calculus, simple methods of integration, some applications of the integral calculus, definite integrals, higher derivatives and functions of several variables, infinite series, maxima and minima, and differentiation and integration of functions found empirically. While we do not consider that the book contains an ideal course of work upon the calculus, yet it is highly to be praised, and should prove of real value to all serious students of the physical sciences.

STANDARD SILVER: ITS HISTORY PROPERTIES AND USES.—II.

By ERNEST A. SMITH, ASSOC.R.S.M., F.C.S.

ALTHOUGH sterling silver was used in England for the manufacture of plate at a very early period, "the Anglo-Saxons being always reckoned skilful in the use of gold and silver," the first statute made for regulating the standard of silver to be used by workers in this metal in England is that of the 28th Edward I., c. 20 (A.D. 1300). It ordains that goldsmiths shall make no worse silver than "silver of the sterling alloy of the coin, or better at the pleasure of him to whom the work

belongeth" (argent del alloy de le esterling ou de meilleur), and that none work worse silver than money.*

From the table given last month it will be seen that the standard for coinage was altered several times during the interval from the 34th of Henry VIII. (A.D. 1542) to the 6th of Edward VI. (A.D. 1552), but the silver used for plate made during this period appears to have remained "as good as the old standard 925; and was not debased like the coin of that period."†

In consequence, however, of the adoption by silversmiths of the practice of melting the coin of the realm to convert it into plate, legislation for the protection of the coin became necessary in the reign of William the Third.

The extent to which the practice of manufacturing plate from the coinage was carried was largely due to the fact that in the reign of James the Second immense quantities of plate had been sacrificed for the use of the King and of Parliament by converting it into money, and that now the opulent gentry were desirous of replenishing their side-boards and tables with plate. The melting of the coin of the realm was, therefore, adopted by the silversmiths as the most expeditious way of obtaining silver "as good as sterling."

In order to prevent this wholesale conversion of coin into plate an Act was passed which raised the legal standard for silver plate above the standard of the coinage, thus rendering the latter less available to the silversmith.

The Act of Parliament (A.D. 1697-8, William III., c. 8, 5, 9) relating to the new standard states that "it might reasonably be suspected that part of the silver coins of the realm had been, by persons regarding their own private gain more than public good, molten and converted into vessels of silver or other manufactured plate, which crime had been the more easily perpetrated by them, in regard the goldsmiths or others, workers of plate, by the former laws and statutes of the realm were not obliged to make their plate of finer silver than the sterling or standard ordained for the monies of the realm." It was therefore enacted that, from March, 1697, no silver plate should be made of less fineness than that of 11 ozs. 10 dwts. of fine silver in every pound troy (or 959 parts of silver per thousand), and that no silver vessels, etc., made after that time, should be put to sale until they had been Hall marked.

In order to distinguish plate of this new standard it was appointed that it should be marked with the "figure of a woman commonly called Britannia."

On account of the softer nature of the new standard, due to the larger percentage of silver present in it, it was found that articles made of this alloy were not so serviceable nor so durable as those made of the old standard.

Copper being a harder metal than silver the relative abrasion suffered by alloys of silver and copper is dependent on the percentage of copper present.

By an Act of Parliament, the 6th of George I., c. 2, s.s. 1 and 41 (A.D. 1719), the old standard of 11 ozs. 2 dwts. (925) was revived concurrently with that of 11 ozs. 10 dwts. (959), and these two standards still exist for plate, though only the former is in general use.

The standard 925 is always spoken of as the "old silver standard of England," while the standard 959, although seldom used, is referred to as the "new silver standard," or sometimes as the "Britannia" standard, owing to the fact that silver wares of this standard, as stated above, are marked with the figure of "Britannia," when sent to the Assay Office to be Hall marked.

The silver standards used in other countries are also fixed by law, and it is of interest to compare these with the English silver standards. In the subjoined table the standards of fineness of silver used for coin and for plate in other countries are given.

TABLE showing the Silver Standards for Coin and for Plate of the Principal Countries of the World.*

Country.	Coins.		Plate.	
	Fine Silver per lb. Troy.	Fine Silver per 1000 parts.	Fine Silver per lb. Troy.	Fine Silver per 1000 parts.
	ozs. dwt.		ozs. dwt.	
America	10 16	900	No fixed	standard
Austria-Hungary ...	10 16	900	11 8	950
Austria-Hungary ...	10 0½	835	10 16	900
Austria-Hungary ...	6 4½	520	9 12	800
Austria-Hungary ...	6 0	500	9 0	750
Austria-Hungary ...	4 16	400	—	—
Belgium	10 16	900	10 16	900
Belgium	10 0½	835	9 12	800
Colonies :—				
Canada, Newfoundland	11 2	925	—	—
Ceylon, Hong Kong, Straits Settlements	9 12	800	—	—
Denmark	9 12	800	9 18¼	826
France	10 16	900	11 8	950
France	10 0½	835	9 12	800
Germany	10 16	900	9 12	800
Holland	11 7	945	11 4	934
Holland	—	—	10 0	833
India (British) ...	10 19	916·6	—	—
Italy...	10 16	900	11 8	950
Italy...	—	—	10 16	900
Italy...	—	—	9 12	800
Japan	10 16	900	—	—
Japan	9 12	800	—	—
Norway and Sweden	9 12	800	9 18¾	828·1
Norway and Sweden	7 4¼	600	—	—
Portugal	10 19	916·6	10 19	916·6
Portugal	—	—	10 0	833
Portugal	—	—	9 12	800
				for export
Russia	10 16	900	10 18¼	910
Russia	10 8	868	10 11¼	880
Russia	6 0	500	10 1·5	840
Spain	10 16	900	10 19	916·6
Spain	—	—	9 0	750
Switzerland	10 16	900	10 10	875
Switzerland	—	—	9 12	800
Turkey	10 16	900	10 16	900
Turkey	9 19	830	—	—
United Kingdom ...	11 2	925	11 2	925
United Kingdom ...	—	—	11 10	959

* Compiled from Parliamentary Return relating to Gold and Silver Marking in Foreign Countries, February 24th, 1890, and from other Sources.

It will be evident from the above table that the standard 900 is now more widely used than any other, England alone employing 925, that is, 11 ozs. 2 dwts. per ounce troy, thus maintaining the connection with Saxon coins.

As previously stated, the silver standard of this country has from very early times been computed by divisions of the troy pound. The adoption of the metric system of weights and measures in most other countries no doubt accounts for the use of alloys of decimal proportions in these countries. Alloys of lower

* Chaffers, "Hall Marks on Plate," 8th edit., 1896, p. 6.

† *Idem*, page 10.

standard have an advantage over those of higher standard, inasmuch as the abrasion suffered by an alloy with 90 per cent. of silver would be less than that suffered by an alloy containing 92.5 per cent. As silver and copper are capable of uniting in all proportions by direct fusion, standard silver is prepared by melting together the requisite quantities of the two metals. The fusion is usually effected in plumbago crucibles, those in use at the Royal Mint having a capacity of 4000 ounces.

Alloys of these metals possess the characteristic pure metallic whiteness of silver until the copper amounts to 50 per cent. of the alloy, and the tint becomes more and more red with the increase in the amount of copper above this limit. The effect of copper is to increase the hardness and elasticity of the alloy, hence silver is always alloyed with copper to obtain the hardness required to enable it to withstand the wear to which coins, etc., are subjected; pure silver, as previously stated, being too soft for the purpose. The hardest alloy of these metals consists of about $31\frac{1}{4}$ per cent. of silver and $68\frac{3}{4}$ per cent. of copper, or a ratio of 5 to 11.

Although the products of the fusion of silver-copper alloys in any proportions are comparatively homogeneous, yet it has long been remarked that ingots of alloys of these metals are not absolutely identical in composition throughout.

Considering that silver-copper alloys of various composition have long been used universally for the purposes of coinage and plate, it is not surprising that this series of alloys has been the subject of careful experiment, and much is now known respecting them. Recent research has shown that one of the most interesting facts connected with them is the remarkable molecular rearrangement they undergo during solidification.

Levol, who is one of the chief authorities on the subject, concluded that the only homogeneous alloy of the series contains 71.89 per cent. of silver and 28.11 per cent. of copper; and he considers this alloy to be a definite compound of the two metals having the formula Ag_3Cu_2. All other alloys of silver and copper Levol regarded as mixtures of this definite alloy with excess of either of the metals.

His experiments showed that in alloys containing more than 71.89 per cent. of silver the centre of the solidified mass is richer in silver than the exterior, while in alloys of lower fineness than this the centre contains less silver than the external portions.‡

Sir Roberts-Austen repeated many of Levol's experiments, and concluded§ that uniformity in composition of the series of silver-copper alloys depends greatly on the method of cooling. By slow cooling many alloys other than the one mentioned above may be made as uniform as it, its peculiarity consisting in the fact that its composition is uniform whether it is cooled slowly or rapidly.

With regard to the homogeneity of English standard silver (925) cast under ordinary conditions, it appears from a long series of experiments made some years ago by Col. Smith for the Indian Mints‖ that the tendency of the silver and copper to separate depends upon the inequality of the rate of cooling in the different parts of the ingot. The act of cooling causes a partial separation or liquation of the copper towards the surfaces which cool first, those parts of the bar being richest in silver which solidify the last.

The researches of Roberts-Austen have shown that the maximum difference in the composition of an alloy containing 925 parts of silver and 75 parts of copper is only 1.40 parts per thousand when the alloy is slowly cooled, while it is as much as 13 parts per thousand when the alloy is rapidly cooled.

The irregularity in the composition of standard silver due to liquation is a matter of great importance in mints where the production of alloys of uniform composition is very desirable.

With suitable moulds and uniformity of cooling liquation may be almost entirely prevented, but unless great care is exercised in the preparation and casting of the alloy the irregularities in the composition will be much greater than those quoted above.

In establishments where standard silver is prepared for trade purposes and is subsequently manufactured into goods to be Hall marked it is the common practice when preparing the alloy to add a little extra pure silver beyond the quantity actually required. This is done in order to overcome the irregularities in composition due to liquation, and to obtain an alloy which will be a little above the standard in all parts and thus satisfactorily pass the Hall.

Standard silver, apart from its attractive appearance, possesses many properties which render it valuable in industrial art. It is very malleable and ductile, and can be readily rolled into thin sheets and drawn into very fine wire. It possesses a brilliant metallic lustre and is capable of taking a high polish. One of its most valuable properties is the readiness with which it may be made to "flow" under pressure. It is well known that "when a malleable metal or alloy is extended by mechanical processes, such as rolling, stamping, or hammering, a true flow of the particles of the metal occurs, analogous in all respects to the flow of viscous fluids. The pressure exerted upon the surface of the metal is transmitted in the interior of the mass from particle to particle, and tends to produce a flow in the direction where the resistance is least."¶

The application of this fact, that solid metals and alloys flow like viscous fluids, is of great importance in industrial art, and the production of various complicated and artistic forms with standard silver by stamping, spinning, chasing, etc., entirely depends on the flow of the metal when suitably guided by the artificer.

The striking of coins presents a familiar instance of this valuable property of standard silver, the metal, under pressure, being made to flow into the sunken portions of the die without fracturing, thus producing a true impression with every detail clearly defined. The stamping of knife handles and small trays also affords a familiar example of this property. The art of stamping and shaping articles of jewellery, etc., in a press from sheets of standard silver came into general use just previous to the first Exhibition of 1851, and a very large quantity of work is now produced by this means.

During the mechanical processes, such as hammering and stamping, the metal becomes more or less hard and brittle, and requires to be annealed at frequent intervals. This is effected by heating the metal to a dull red heat in a non-oxidising atmosphere, whereby its original softness is restored.

‡ *Ann. de Chim. et de Phys.*, Vol. 36 (1852), p. 193; Vol. 39 (1853), p. 163.

§ *Proc. Roy. Soc*, Vol. XXIII. (1875), p. 481.

‖ *Idem*, p. 433.

¶ Percy. "Metallurgy," Vol. I., page 22.

By the application of certain processes the surface of standard silver may be made to assume various tints, by which means the artistic effect is increased.

When silver-copper alloys are heated to dull redness, with access of air, the surface becomes blackened, owing to the formation of a film of copper oxide, but by blanching—that is, immersion in hot dilute sulphuric acid—the copper oxide is dissolved, and the silver assumes a beautiful dead-white appearance known as "frosted" silver.

When silver articles have been thus frosted and the portions in relief are burnished, very effective results are often obtained, and the beauty of the ware greatly enhanced.

Articles of plate may be "frosted," or, as it is sometimes termed, "matted or deadened," also by boiling them in bisulphate of potash, which acts in the same way as dilute sulphuric acid.

In order to obtain on ornamental silver wares the effect known as oxidized silver, the surface is darkened by a thin film of silver sulphide, produced by boiling the articles in an aqueous solution of potassium sulphide, and then rubbing with very fine pumice, which removes the dark layer of silver sulphide from the portions in high relief and leaves dark lines in the more deeply-cut recesses.

The effect thus produced is frequently very striking, and adds materially to the appearance of the article.

At the Paris and London Mints** silver medals have recently been subjected to the process known as "sand blasting," by the aid of an appliance which projects against the surface of the medal a small jet of air carrying with it fine sand, and having a velocity of about 180 feet per second. When thus treated, the surface of the medal becomes "frosted," and may be subsequently oxidized as above described, or the following process may be adopted. The "frosted" medal is immersed in an alcoholic solution of platinum chloride, whereby the surface becomes blackened by the deposition of a thin film of metallic platinum. Subsequent rubbing with a brush and very fine pumice changes the blackened surface to a delicate grey, and if this operation is conducted skilfully, graduated shadows may be left wherever the artist considers their presence to be desirable. The beauty of the medals so treated, and the fidelity with which the details of the design are revealed, is beyond question, but it may be doubted whether the surface of the medal is permanently protected.

(To be concluded.)

THE WHITE NILE—FROM KHARTOUM TO KAWA.

AN ORNITHOLOGIST'S EXPERIENCES IN THE SOUDAN.

By HARRY F. WITHERBY, F.Z.S., M.B.O.U.

II.—THE RIVER—ESSENTIAL ALIKE TO MAN, BEAST AND BIRD.

HAVING obtained all the necessary permits as well as baggage and riding animals, our next task was to engage servants. We eventually gathered together a motley and somewhat amusing crowd. The chief of these—one Hassan Mahomet Eshari, an Egyptian—we brought from Cairo, and he proved in every way an excellent interpreter and hard-working headman and servant. Mustapha, who hailed from Berber, was a cook as well as a lazy and perfidious rascal. Mahomet—an old kingly-looking Turk, whose ankles were callous through the shackles of the Khalifa—was "sais" to the donkeys. He was a fine figure, and generally rode in front of our caravan, ordering the natives out of the path, or commanding them to come and show the way for a mile or two, all in a most dignified manner. But when it came to work in camp his one idea was to sit on his haunches and smoke, and to obtain the services of the nearest wandering boy to wait upon him and his donkeys. The natives feared him much, and generally obeyed him without a murmur, but all our hard sayings and harder doings failed to make much permanent improvement in his habits.

We had great expectations of Mirsal, an old Soudanese soldier, who was to act as a gun-bearer. When I engaged him he went through a most charming pantomime. Gripping his right arm with his left hand, he swore by the Prophet's beard that so long as there was strength in that arm he was my most faithful servant. A few days later, when on the march, we sent him over to a village on the other side of the river with money to buy food and tobacco. We never saw him again, nor could policemen mounted on camels find him. But maybe we misjudged him. The strength may have forsaken his arm. Our camel men were from Dongola. They were a lively, irresponsible crew, requiring much physical persuasion. On the whole, we were not greatly impressed by the reliability of the natives of the Soudan, as far as concerns either work or honesty.

Our final plan was to travel up the river quickly, and to return slowly. While marching up the river we, of course, should have no time for collecting or preserving, but we should be able to make notes of the birds and the country, and thus obtain a knowledge of the ground which would greatly assist us on our return in deciding where to make collecting camps, and how long to stay at each.

Mahomet at Work.
From a photograph by Mr. C. F. CAMBURN.

With much kind help from many in authority at Omdurman all our preparations were at last complete, and on the afternoon of March 20th, we sent our men, animals, and baggage across the White Nile to the Khartoum, or east, bank. Joining them early the next morning we found to our great relief that there were no deserters, and, moreover, that all disputes as to which box or package should be carried on which camel were settled, and all were ready to start. The apportionment of loads and the loading up at the start are always difficulties, and never before had we experienced so little trouble.

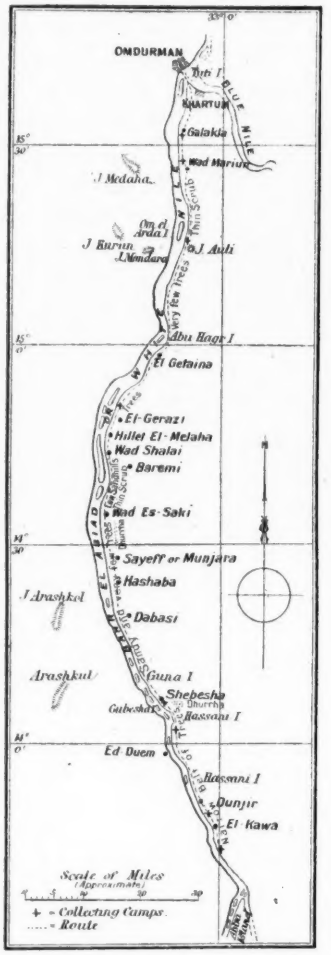
** 28th Report of Royal Mint, 1897, p. 47.

It is remarkable how regular a stride and how even a pace the baggage camel will keep up hour after hour. Two and a half miles an hour is his pace, and twenty miles is for him a good day's journey. As the camels carried our food, tents, beds, and indeed all our baggage, we had to arrange our day's march according to theirs, our procedure being generally as follows:—Rising just before the sun (about 5 o'clock) we breakfasted, struck tents, packed up and got away about seven, marched for five hours, then rested during the heat of the day, and marched again for some two or three hours in the afternoon, getting into camp as the sun was going down, about 6.30. We travelled thus to a point some ten miles south of a town named Kawa, on the east bank of the White Nile, about 150 miles south of Khartoum, and there we stopped and made our first collecting camp.

A reference to the accompanying sketch map will give an idea of our route. We marched as a rule close along the river, which was in many ways more convenient and pleasant than the desert track. At high Nile the route by the river is impossible, as much of the land is then flooded, and long detours here and there are necessary to avoid the "Khors" (equivalent to the South African "dongas"), some of which during the rains are often impassable torrents, whereas in the hot season they are merely dry watercourses. Often we rode for miles along the narrow strip of short grass which in places grows by the river, but now and again this pleasant going gave way to soft sand which was trying for the donkeys, and, if a heavy wind was blowing, disagreeable for us. But more annoying still, and more frequent, were the wide stretches of mud covered by the river during its flood, but now hard, caked and cracked in every direction by the powerful sun. So large and deep were these cracks, and so numerous, that our donkeys continually got their legs into them, the result often being a sudden collapse of the beast and the discomfiture of the rider, while sometimes a donkey's legs became so firmly fixed in a crack that it required our united efforts to lift him out again. After due experience of this method of travelling we avoided the wider stretches of mud by turning off into the desert track, which although hot and dusty, was at all events firm.

One does not need to travel far up the White Nile in the dry season to be impressed by the glaring fact that the life of every man, beast and bird in the country is entirely dependent upon the river. Beasts such as camels and even goats can be gradually trained to exist without water for as long as two or three days, but man cannot live long in this burning country without the life-giving water, as many a poor wretch has proved, while birds are even more dependent upon it. There is no dew, and save for a small well here and there at long intervals, water can only be had at the river. Man, or rather woman for him, has to come there to get his water, and thither he has to drive his camels, cattle and goats, often from long distances, to drink.

To the river every morning and evening, as regular as clockwork, flock after flock of sand-grouse and pigeons come down to drink. All day long small birds are passing to and from the trees and bushes to the river's edge, while at dawn or in the evening, wild beasts of many kinds come from their haunts on the same errand. But man is dependent upon the river not only for the water he drinks, but largely also for his food. It is true that much "dhura," the corn of the country, is grown during the rainy season out of reach of the Nile even at its greatest height, but by far the larger part and the richer part of the cultivatable land is the mud which so troubled our donkeys, and this mud is entirely dependent upon the flooding of the river to render it fit for agriculture. The same may be said of the islands in the river, which are covered at high Nile, and afterwards prove of the utmost value for cultivation. So rich is the land on these islands that even the lazy Soudanese find it worth their while further to utilize the river by raising the water with the "shadoof," and so continue cultivation during the dry season. At the time of our journey these islands were almost the only green spots in a wilderness of brown and sun-scorched land. At long intervals only, did one or two "shadoofs" keep green some small patches of onions, water melons or beans on the mainland.



Sketch Map, showing route and collecting camps.

As a highway, the river is extremely valuable. Sailing boats of various kinds—gyassas, feluccas, nuggars and even dahabiehs—are continually travelling up and down laden with corn and other produce, while rafts of all sizes are numerous. The timber forming a raft is generally of the "sont" tree, a species of acacia, and is cut by a few natives who join together for the purpose. When the wood is cut and floated, and the raft completed, they thrust it out into the river, and are then entirely at the mercy of the current, which flows some one or two miles an hour in the dry season. These men make their home on the raft, protecting themselves from the sun by improvising awnings of the cloths which they wrap round their bodies at night. Eventually the current carries them to Omdurman, where they get a good price for the wood as fuel, which is exceedingly scarce near the town.

Besides the sailing boats and rafts, steamers ply up and down the White Nile at least three times a month, to carry passengers, and to take rations and other things to the troops stationed at various points. Now that a channel has been cut through the Sudd on the upper White Nile the river is navigable for 1000 miles south of Khartoum. From Cairo to Khartoum is some 1500 miles by river. Some day when channels have been cut through the cataracts, by no means a very remote pro-

bability, it will be possible to steam 2500 miles up this wonderful river at all times of the year.

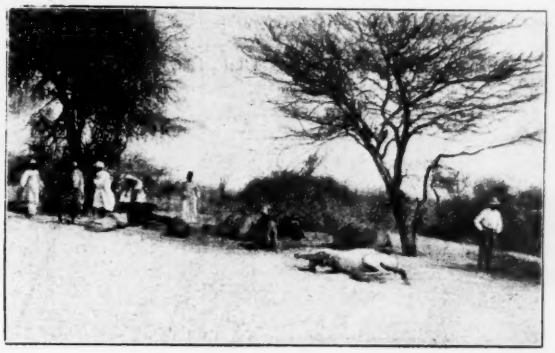
The wild life in the river and along its banks was a continual source of pleasure to us as we rode along. Hippopotami were rarely seen, but now and again an enormous black head would show above the water for

Boatbuilding on the White Nile.
From a Photograph by Mr. C. F. Camburn.

a few moments, and sometimes a long black ridge in the middle of the river would denote where a hippo was resting on some sandbank barely covered by the water. We often saw gigantic footprints on the bank, where one of them had come out of the water to feed, and at night the natives light fires at intervals along the river side to keep the great beasts in the water, for a patch of beans is little to boast about after even one hippopotamus has been browsing in it.

Much further south than we travelled the hippo is exceedingly common, and notwithstanding the restrictions, many must be killed if one may judge by the universal use of the "Korbag," a whip which is made out of its hide. It is curious how this whip, which, by the way, we found very useful for both man and beast, is employed under various names (such as "sjambok" in the south) all over Africa. Crocodiles were common and were often to be seen, sometimes three or four together, lying asleep on the bank, facing the breeze with their mouths wide open. Once we saw two calves standing unprotected at the water's edge, and just as we passed, the ugly head of a crocodile appeared within ten yards of them, but it slowly drew back on seeing us. As a rule the natives make a ring of thorn bushes in the river where they water their goats and cattle to protect them from the crocodiles. But they seem to have no fear of the reptiles for themselves. They wade out into the river to fetch water; if a boat sticks on a sandbank the crew jump out without hesitation; and, more remarkable still, fishermen may often be seen standing motionless up to their shoulders in the water while fishing with nets. The natives are very fond of the flesh of the crocodile, and once when I had shot, but failed to kill, one of the reptiles, our camel men threw off their clothes and rushed into the river in the hope of "tailing" it. It is true that the men were hungry at the time, having squandered their money upon "merissa" or "boozer," and having had little to eat for some time, with the exception of a large fishing eagle, which they had consumed with avidity some hour or two after it had been shot. A specimen of this eagle, the vociferous sea-eagle,* may be seen at the Zoological Gardens in London. With its white hood it is a conspicuous object, and a fine looking bird when perched upon some tree or on some snag in the river, but near at hand it is dirty and disappointing looking, and to my taste decidedly unappetising.

Other birds** abounded in the river and on its banks. Nile geese† were numerous, but very wary. The white man shoots at them with every sort of firearm at every sort of range, for their flesh is good, and the natives, with shouts and sticks and stones worry them out of their bean crops. Another much handsomer and larger goose, the spur-winged goose,‡ was rarer, and so cautious that we were never able to shoot a specimen. Cranes, storks, ibises, and herons of various kinds were generally



A Midday Halt.
From a photograph by Mr. C. F. Camburn.

in sight wading in shallow water or stalking about on the short grass by the river. We sometimes passed within a few yards of a group of crowned cranes,§ with their rich colouring of black, white, and chestnut, and their curious tufts of golden grass-like feathers, and at one camp a confiding old bird used regularly to roost on the top of a tree near our tents until he was added to our collection. The sacred ibis,‖ celebrated by having been much mummified, and by its many portraits upon the tombs and temples of ancient Egypt, was most confiding. This bird only visits Egypt during the period of inundation, and consequently very few travellers in that country see it, the buff-backed heron being made to do duty for it by the tourists' dragoman. However, the real thing is totally unlike the substitute. Its jet black head and neck, which are bare of any feathers, and its black legs, serve to accentuate the pure white plumage of its body, while its wings are edged with black like a mourning envelope, and from each shoulder droop green-black feathery plumes. When flying towards one the bird seems to be streaked with blood, for the wing-bones are bare of feathers on the under side, and the skin which covers them is of a rich vermilion colour. At intervals along the river were beds of shell fish (Aetheria) like oysters. The Nile fell so low in 1900 that a great many of these "oysters" were left high and dry, and were consequently decomposing. Yet numbers of wading birds frequented the beds, and

* *Haliaëtus vocifer*, Daud.

** For a full account of the birds collected and observed during the expedition see the *Ibis*, April, 1901, pp. 237-278.

† *Chenalopex ægyptiacus*, Briss.

‡ *Plectropterus rüppelli*, Sclat.

§ *Balearica pavonina*, Linn.

‖ *Ibis æthiopica*, Lath.

amongst them none were more conspicuous than the Marabou storks,¶ the African representative of the adjutant of India. Not only were they conspicuous by their size and form, but their dull-looking plumage, their bare reddish-yellow heads, and their enormous dirty bills, gave them a most revolting appearance. They are carrion feeders, and seeing them smash open the oyster shells with their massive and powerful bills one could well understand how it was that after the battle of Om Debreikat many a man, well accustomed to gruesome spectacles, shuddered at the sight of corpses mutilated by these birds. Another interesting member of the stork family which frequented the "oyster" beds was a sombre coloured bird with a thick whitish bill, the mandibles of which are so grooved near their tips, that an open slit is left when the bill is closed, a peculiarity which has given the bird the name of open-bill.** Of the many other birds frequenting the river the pelicans†† were, perhaps, the most striking. One evening as we urged our mounts over the brow of a small sandhill we came suddenly in sight of a great flock of these birds in the shallow water at the river's edge. Some were dozing, others were preening their rose-white plumage, others were dabbling their clumsy-looking bills in the water and washing their yellow pouches, while over the whole flock the setting sun threw a delicate rosy hue.

For so large and heavy a bird the flight of the pelican struck me as being peculiarly graceful. A few powerful flaps are given as the bird rises slowly off the water, then the wings are outstretched and it skims straight and swiftly along within a foot of the surface for some hundred yards, then curving slightly upwards, it flaps its wings again and is prepared for another long floating flight.

Before leaving the river and its attractive birds, the black-headed plover,‡‡ or courser, a bird somewhat smaller than the golden plover, deserves mention if only on account of the interesting and historical habits accredited to it. There can be little doubt that this bird is the "τροχίλος" of Herodotus, who ascribed to it the habit of attending crocodiles, and of feeding in their open mouths. At least two naturalists in modern times have actually observed the bird thus act. Some ornithologists, however, are disinclined to believe that it does really enter the crocodile's mouth, and suggest that when a crocodile is lying with its mouth wide open, a bird running about on the sand behind the mouth would appear at a little distance to be actually between the reptile's jaws. However this may be it seems a pity now to discredit a habit which has made the "crocodile bird" a celebrity for so long a time. I am sorry to be unable to give any evidence on the subject. The bird was very common along the banks of the White Nile, and we much admired its rapid and graceful actions and its beautiful plumage of delicate blue-grey marked with white and black, but we never saw it near enough to a crocodile even to suspect it of engaging in the laborious and risky task of picking the reptile's numerous and merciless teeth.

¶ *Leptoptilus crumeniferus*, Cuv.

** *Anastomus lamelligerus*, Temm.

†† *Pelecanus onocrotalus*, Linn.

‡‡ *Pluvianus ægyptius*, Linn.

Note.—It should have been stated in my first article (KNOWLEDGE, April, 1901) that the photographs from which it was illustrated were taken by Mr. C. F. Camburn, one of the taxidermists who accompanied me on the expedition.

British Ornithological Notes.

Conducted by HARRY F. WITHERBY, F.Z.S., M.B.O.U.

EARLY APPEARANCE OF THE NIGHTJAR IN HAMPSHIRE.—On May 5th I put up a Nightjar near Burley, in the New Forest. As is well known, the bird rarely arrives in England before the middle of May, and the 5th of the month is undoubtedly an unusually early date for its appearance. Judging from the experience of several correspondents as well as from my own, the bulk of the migrants have arrived this spring at their usual dates. The late spring in this country could of course have no influence on birds coming from a distance, but the season has been cold and backward, seemingly, in the south of Europe, and it is surprising what little influence this has upon the regularity of the return of our summer migrants.—HARRY F. WITHERBY.

MIMICRY BY THE BUTCHERBIRD.—It has been said that the Great Grey Shrike imitates other birds for the purpose of attracting them within range of attack (Yarrell, British Birds; Ed. 4, Vol. I., p. 201). Yarrell noticed that the Red-backed Shrike or Butcherbird has a note like that of the Housesparrow. In "The Evolution of Birdsong," I suggested that this note might be the loud "chell" or "tell" of alarm given by the Butcherbird, and which is somewhat similar to a note of the Sparrow. On the 5th of May, however, I obtained evidence supporting the idea of voluntary mimicry on the part of this bird. In company with Mr. A. E. W. Paine, of Swords House, Leddington, Ledbury (a life-long observer of birds), I was cycling across some open land, and saw within ten yards of the road a Butcherbird on a post, evidently singing. The bird seemed to fear no harm from cyclists, and continued its song while we passed. We both heard it give in its warble very distinctly the "twink" or "pink" of the Chaffinch. A thick hedge commenced at the spot, and in the shelter of it we dismounted and listened to the curious babbling song of the bird, and heard it utter some notes closely like those given by a Sparrow when singing. One feature of the song (and I heard the same in a captive Butcherbird) was the alternation of soft and loud passages in one strain. A minute later a noisy cart rapidly passing scared the bird to a distance, where he began to feed. I watched him for some time through a telescope. No other birds were near, except a few Sand Martins.—CHARLES A. WITCHELL, Charlton Kings, Cheltenham.

ARRIVAL OF SWALLOWS.—I can report the sight of my first Swallows this year, on April 8th. The dates for seven years past on which I have first seen Swallows here are as follow:—1895, April 10th; 1896, April 12th; 1897, April 7th; 1898, March 14th; 1899, March 29th; 1900, April 15th; and 1901, April 8th. I saw the first Swifts this year on April 19th.—E. SILLENCE, Romsey.

Ornithological Notes from Norfolk for 1900. By J. H. Gurney, F.Z.S. (*Zoologist*, April, 1901, pp. 121-140). For many years Mr. Gurney has contributed to the pages of our contemporary a useful and interesting record of the ornithological events occurring during the year in Norfolk. As far as rarities were concerned, 1900 was uneventful. At the beginning of January a good many Bitterns were reported. During February and March a very large number of Little Auks were washed up on the East Coast. In 1895, it will be remembered, there was a similar incursion all along our eastern seaboard, but in 1900 the birds seem to have kept more together, and most of them perished in Norfolk. Previously recorded irruptions of the Little Auk in Norfolk have occurred in October, 1841; December, 1848; November, 1861. It is satisfactory to learn that Spoonbills continue regularly to visit Norfolk in slightly increasing numbers. With Mr. Gurney's observation that the Tawny Owl does not leave castings in its nesting hole we cannot agree, having repeatedly found the reverse the case.

Conducted by M. I. CROSS.

FINE ADJUSTMENTS.—In the details of the construction of microscopes, as in fact in every other instrument or machine, there is no real finality, and each year sees the introduction of some slight improvement which may tend to make work easier and more accurate. A study of the catalogues of the various microscope manufacturers of a year or two ago will afford food for reflection, for nearly every noted maker then expressed his unbounded confidence in his particular form of fine adjustment. One states that his "must be considered to be a triumph of mechanical skill," another "has proved absolutely satisfactory," and a third "its reliability is unsurpassed." Yet within the space of a few months nearly all the leading makers found it desirable to introduce new devices for fine adjustments. All of them have distinctive features, indicating that care and consideration have been given to their design, and it will probably prove of interest to readers to be made acquainted with such particulars as I have been able to collect from the various makers, for every new idea which enables the worker to manipulate more precisely than available means have permitted him formerly to do, should receive both consideration and recommendation.

A perusal of the paper read before the Royal Microscopical Society, by Mr. E. M. Nelson, and reported in the Society's *Journal* for August, 1899, on the "Evolution of the Fine Adjustment," conveys some idea of the gradual improvement that has taken place in that movement.

Those who use a substage condenser giving a small aplanatic cone will probably not feel the necessity of a better fine adjustment than that which is usually fitted to student's stands having the direct pillar action.

Directly an illuminating cone bearing a fair proportion to the numerical aperture of the objective is used, the necessity for a slow and precise movement by fine adjustment becomes overwhelmingly apparent.

In a previous article I referred to the fact that many new substage condensers yielding large cones of illumination had been recently introduced, and as the supply of such articles must indicate a demand, it necessarily follows that people who have used them have discovered the weakness in the fine adjustments of their instruments, have called for something better, and response is being made by manufacturers to meet this fresh demand.

There are four new fine adjustments which I propose to review, as follows:—The Continental pillar fine adjustment with levers, designed by Reichert, of Vienna; the new fine adjustment fitted to their photo-micrographic stand, by Zeiss; the "Ariston," by Swift and Sons; and Stringer's fine adjustment, by W. Watson and Sons.

REICHERT'S FINE ADJUSTMENT.—The great weakness of the Continental pillar form of fine adjustment has been consequent principally on the difficulty of producing a sufficiently slow rate of movement with a direct-acting screw that would stand wear and tear. The problem has been met by Reichert's device, which consists of a screw, having a point which engages two lever arms, the upper pressing upon the lower, and being mounted from the outer sides of the pillar. To the under sides of these levers is attached a piece of hemispherical shaped metal, which has on its curved side a point which communicates the motion.

A reference to the illustration in our next number will make this otherwise obscure description quite clear, and it will be further seen that the rate of movement is diminished by the proportions of the lever arms, which are about 2½ : 1. This would mean that if a screw of the ordinary kind were used, the rate would be reduced to $\frac{1}{250}$ in. for each revolution instead of $\frac{1}{100}$ in. as in the old pattern.

(The illustration referred to in the above note will appear in the July number of KNOWLEDGE.)

THE MICROSCOPE AND THE PHARMACEUTICAL CHEMIST.—To the busy medical practitioner, reference to the microscope for diagnostic purposes is a matter of every-day occurrence. Those who have not the time or disposition to do the work themselves, have at their disposal associations and laboratories which cater for their special needs. In addition to these facilities, it is becoming usual for pharmaceutical chemists to make themselves acquainted with the wants of medical men in these respects, and to be prepared to make the examinations, and to provide themselves with the necessary modern apparatus for so doing.

The microscope is becoming increasingly important in the curriculum of the pharmaceutical student, and it is in no small degree due to this profession that so much of our food and drugs that once were adulterated, are now purer and of better quality. Powdered drugs and spices were frequently mixed with starches, flour, etc., but the microscope quickly discloses such foreign materials. The knowledge of active constituents and other cell contents of medicinal plants, and their distribution in different tissues and organs is becoming increasingly comprehensive and accurate, and experiments aided by the use of special micro-chemical reagents are in progress to identify the vegetable alkaloids and related substances microscopically.

It is a satisfaction to know that work of so thorough a nature is in progress, and it is a guarantee that with increased and more general expert knowledge, our food, drugs, and other commodities will be purer and finer than they have been.

THE WORKSHOPS OF E. LEITZ, WETZLAR.—A correspondent sends a description of his visit to the microscope factory of this noted optician. The following is a short *resumé*:—

5000 microscopes per annum is the output of this house, leading one almost breathlessly to ask "What becomes of them all?" Leitz's great feature is that he confines himself entirely to microscopes and their accessories, instead of producing scientific instruments of every description as English opticians generally do. Herein lies the secret of his success.

With a large and regular demand for certain fixed models, a system of production in which machinery plays an important part is possible, and ensures sound construction with a minimum of cost. The supervising and testing departments are of the most thorough description, and when the care that is taken is known, it is not to be wondered at that the Leitz objectives are credited with being more uniform in quality than any others.

It has many times been stated that the reason why Continental houses produce cheaply is because they employ women workers. Leitz has no female labour at all; all his men are skilled mechanics, the majority of whom have been trained in the works.

It is quite possible for English houses to compete successfully with foreign competitors if they do but adopt their methods, which may be summarised in a few words. Have the works in a country town where rents are low, and the cost of living less than in London. Have suitable buildings for workshops, and the rest is a matter of system and machinery.

NOTES AND QUERIES.

H. Dewey.—The two books that are likely to give you the information you require are "A Popular Hand-book to the Microscope," by Lewis Wright, price 2s. 6d., and "Modern Microscopy," by Cross and Cole, price 3s. 6d. More costly works are "The Microscope," by Hogg, new edition, price 10s. 6d., and "The Microscope and its revelations," by Carpenter, edited by Dr. Dallinger, a new edition of which is promised for next July.

CHALK WITH SHELLS.—In a previous number I offered to send a correspondent a supply of Foraminiferous Limestone. Several readers have asked that I would also give them some. I shall have much pleasure in complying with their requests if

they will kindly accompany their application with stamps to cover cost of postage on the material.

RED RAIN.—In connection with the recent falls of so-called red rain, I have received letters from two correspondents, one of whom enclosed a small quantity of material distributed by Captain C. J. Gray, which had been collected by him after a heavy fall of rain on December 28th, 1896, in Melbourne, Australia. I have had the material mounted, but the quantity which I received did not contain the variety of matter that some other correspondents have noted. Observed by transmitted light, there were few characteristic particles, but with the aid of a polariscope I was able to detect some small crystalline fragments of the nature of quartz, etc. It seems more than probable that the phenomenon arose in consequence of one of those heavy winds which have been known to carry dust from the Sahara as great a distance as 500 miles, and which in this case may have passed over some sandy tract in a like manner. The material has all the appearance of such dust. There are some interesting references to falls of red rain in P. H. Gosse's "Romance of Natural History," but none of them are of the same nature as the dust at present under consideration.

Dr. H. M. Whelpley.—I have to give you my best thanks for so kindly sending the numerous interesting papers in connection with chemical and pharmaceutical subjects, and especially for the engraving of the Pre-columbian Indian Flint Implement. This is certainly a most interesting and perfect specimen.

Communications and enquiries on Microscopical matters are cordially invited, and should be addressed to M. I. CROSS, KNOWLEDGE *Office, 326, High Holborn, W.C.*

NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

LARGE COMETS.—Prof. A. Kreutz, editor of the *Astronomische Nachrichten*, has recently issued a work giving the results of his computations and comparisons of the orbits of the comets of 1680, 1843 I., 1880 I., 1882 II., 1887 I., etc. These several objects offered some suggestive resemblances both as regards their physical features and their orbital elements. But they appear to have been, individually, distinct bodies revolving in ellipses of long period. They exhibited, however, a sufficient all-round similarity to warrant the inference that they originated from the same source, and may have primarily formed an immense comet, which encountered disturbances of such force as to disconnect its materials, and distribute them into a family of large comets of various periods, and with perihelia remarkably close to the sun. The time of revolution of the comet of 1680 was about 8449 years, of 1843 I. 511 years, of 1880 I. and 1882 II. 800 years; but in the case of 1887 I. the elements are extremely uncertain, the comet being only observed on a few nights in the Southern Hemisphere. Certain other bright comets, in addition to those specified, exhibited features of orbit and aspect which indicate their possible identity with the class alluded to, but the observations were not very accurate, and reliable conclusions cannot be deduced from them.

NEW COMET.—On April 23rd, a telegraphic dispatch from Sydney reported that a brilliant comet was seen in Australia, and the same object was observed at Capetown during the two hours preceding sunrise. It had a triple tail ten degrees in length. The astronomers at Yerkes's Observatory are said to have picked up the comet on the morning of April 27th, and it was seen by several observers at Eastbourne, according to the newspapers, on May 1st, at 3 a.m., but as the comet did not rise in England until after 6 a.m. on that morning the observers must have been deluded by some false appearance. The perihelion passage occurred on April 24th, at a distance of about 23 millions of miles from the sun. The following extracts from an ephemeris by Kreutz, *Ast. Nach.*, 3712, will show that during May the comet rapidly receded from the earth, and became so faint as to be practically invisible in the strong twilight of the season:—

Date.	R.A. H. M. S.	Dec. ° ′	Brightness.	Distance from Earth in Millions of Miles.
May 4 ...	3 57 49	− 0 14·4	... 0·37	... 82
,, 14 ...	5 31 49	+ 3 25·9	... 0·09	... 107
,, 24 ...	6 20 18	+ 6 21·2	... 0·03	... 138

On June 1st, the comet will be about one-hundredth part as bright as it was when near perihelion, and will be situated in about 100° + 8°, so that this object which afforded such a conspicuous aspect in the southern hemisphere, has virtually come and gone (like the fine comets of 1880, February, and 1887, January) under conditions which prevented a single glimpse being obtained by northern observers.

THE APRIL METEORS.—The weather generally was very favourable for the observation of these objects, and moonlight offered no interference until the later stages of the display. Usually meteors are very scarce in April, and this year proved no exception to the rule. At Bristol the writer obtained observations on April 13th, 17th, 18th, 19th, 20th, 21st, 23rd and 24th, and during watches amounting in the aggregate to 19 hours saw 122 meteors. The first Lyrid was recorded on April 18th, at 13h. 19m., and it was fortunately also mapped by Prof. A. S. Herschel at Slough. It descended at a normal elevation above the earth's surface, and its radiant at 266° + 33° proves that this centre, like that of the Perseids, moves eastwards during the time of its visibility. On April 20th, during a watch of five hours the writer noticed 29 meteors, but there was not a single Lyrid amongst them! Yet, on April 21st, during a watch of 3¼ hours 25 Lyrids were seen, and 27 other meteors. It was evident that on this night the shower reached a definite maximum. Allowing for time spent in registering the paths, etc., the horary number of Lyrids for one observer was about eleven. The radiant point on April 21st was at 270° + 33°, showing an easterly drift of 4 degrees of R.A. (equal 3 degrees of space) during the three nights. The following ephemeris will probably represent the place of the radiant pretty accurately on eleven nights, and it will be important to test it by future observations, but the shower is exceedingly feeble at its earlier and later stages, so it will be advisable to incorporate the paths of different observers:—

Date.	α °	δ °	Date.	α °	δ °
April 15 ...	263½	+ 33	April 21 ...	271	+ 33
,, 16 ...	264¾	+ 33	,, 22 ...	272¼	+ 33
,, 17 ...	266	+ 33	,, 23 ...	273½	+ 33
,, 18 ...	267¼	+ 33	,, 24 ...	274¾	+ 33
,, 19 ...	268½	+ 33	,, 25 ...	276	+ 33
,, 20 ...	269¾	+ 33			

1900 not being a leap year the effect will be that for some time in the future the maximum will occur one day later than formerly. Thus the Quadrantids will occur on January 3rd instead of January 2nd, the Lyrids on April 21st instead of April 20th, and the Perseids on August 11th instead of August 10th. The recent display of Lyrids was successfully observed by several observers in various parts of England. Prof. Herschel at Slough made a considerable number of accurate observations, and remarked the singular scarcity of meteors except on the special night, April 21st. He then saw 18 Lyrids in about three hours, nearly all 1st or 2nd magnitudes. Mr. C. L. Brook, of Meltham, near Huddersfield, counted between 40 or 50 meteors on April 21, including a number of Lyrids. One of the most brilliant of these appeared at 10h. 8m., and was also recorded by Mr. T. H. Astbury, at Wallingford, and the writer at Bristol. It fell from a height of 79 to 51 miles over the Midlands. But the most interesting meteor observed at more than one station during the recent display was that of a bright Cassiopeid which came into view at 11h. 22m. on April 21. Its radiant, from observations at Meltham and Bristol, was at 21° + 59° near δ Cassiopeiæ, and it descended from 66 to 44 miles in a path of 55 miles, directed from north to south over the counties of Carnarvon, Merioneth, and Cardigan, in Wales. Its velocity was 14 miles per second. It is remarkable that slow-moving fireballs often take their flights from this radiant near δ Cassiopeiæ in the spring months of April and May, though ordinary shooting stars come rarely from that focus in the vernal season. The fireball of 1891, April 2, had a radiant of 29° + 55°; that of 1876, April 9, at 17° + 57°; that of 1874, April 10, at 19° + 57°; that of 1893, April 15, at 15° + 59°; and that of 1877, May 30, at 20° + 58°. The various catalogues of meteoric observers contain other instances of brilliant slow-moving April meteors from the same radiant in Cassiopeia.

THE FACE OF THE SKY FOR JUNE.

By A. FOWLER, F.R.A.S.

THE SUN.—On the 1st the sun rises at 3.52, and sets at 8.4; on the 30th he rises at 3.49, and sets at 8.18. He enters Cancer, and Summer commences on the 22nd at 3 A.M. Few sunspots are to be expected.

THE MOON.—The moon will be full on the 2nd at 9.53 A.M., will enter last quarter on the 9th at 10.0 P.M., will be new on the 16th at 1.33 P.M., and will enter first

quarter on the 23rd at 8.59 P.M. The following are among the occultations visible at Greenwich during the month:—

Date.	Name.	Magnitude.	Disappearance.	Angle from North.	Angle from Vertex.	Reappearance.	Angle from North.	Angle from Vertex.	Moon's Age.
				°	°		°	°	d. h
June 4	μ Sagittarii	4·1	2.4 A.M.	111	104	3.13	229	212	16 20
,, 4	D.M.—19°5273	5·9	11.52 P.M.	31	52	12.41	312	326	17 18
,, 5	B.A.C. 6536	5·5	2.49 A.M.	102	95	3.59	227	210	17 21
,, 8	σ^1 Capricorni	5·2	2.59 A.M.	109	126	3.54	201	208	20 21
,, 25	B.A.C. 4531	5·7	7.57 P.M.	101	94	9.18	302	283	9 7
,, 28	ω^1 Scorpii	4·1	11.15 P.M.	53	37	12.15	315	291	12 10
,, 28	ω^2 Scorpii	4·6	11.30 P.M.	109	82	12.48	267	249	—

Attention may be specially drawn to the occultation of ω^1 and ω^2 Scorpii on the night of the 28th.

THE PLANETS.—Mercury is an evening star throughout the month, reaching greatest easterly elongation of 24° 39′ on the 16th, and, apart from the strong twilight, is very favourably situated for observation. On the 10th, he sets 1h. 55m. after the sun; on the 16th, 1h. 45m.; and on the 18th, 1h. 40m. after the sun. On the 16th the planet will be to the south-west of Castor and Pollux, roughly at the same distance from Pollux that this star is from Castor.

Venus is an evening star, having passed superior conjunction on May 1st. At the middle of the month she sets a little less than an hour after the sun, and at the end of the month almost exactly an hour after the sun.

Mars may still be watched in the early evening. On the 1st he sets a little before 1 A.M., and on the 30th about 11.20 P.M., his apparent diameter diminishing from 7″·2 to 6″·2. On the 15th the illuminated part of the disc will be 0·890, the planet having passed quadrature on May 28th. The path is direct, or easterly, through the south-eastern part of Leo.

Jupiter may be observed before midnight throughout the month, rising on the 1st a little before half-past ten, and on the 30th a little after eight. The planet will be in opposition on the 30th, but as his declination is then 23° south, his altitude on the meridian in London will be less than 16°. The path is retrograde, or westerly, through Sagittarius. On the 15th the apparent polar diameter of the planet will be 43″. The more interesting satellite phenomena at convenient hours are as follows:—

		H.	M.	S.			H.	M.	S.
22nd.—	I. Ec. D. ...	11	4	14	28th—	IV. Sh. I. ...	9	23	0
23rd—	I. Sh. E. ...	10	27	0		IV. Tr. I. ...	9	47	0
	I. Tr. E. ...	10	38	0		IV. Sh. E. ...	11	30	0
25th—	II. Ec. D. ...	11	53	41		IV. Sh. E. ...	11	54	0
26.h—	III. Sh. E. ...	10	26	0	30th—	I. Tr. I. ...	10	4	0
	III. Tr. E. ...	10	49	0		I. Sh. I. ...	10	4	0
27th—	II. Sh. E. ...	9	47	0		I. Tr. E. ...	12	21	0
	II. Tr. E. ...	9	56	0		I. Sh. E. ...	12	21	0

Attention has been drawn by Mr. Crommelin to the specially interesting phenomena on the 30th, on which date there will be a transit of the earth across the sun's disc as seen from Jupiter. Satellite I. will almost occult its own shadow on the planet, but as the shadow will be slightly the larger, a dusky ring may be expected to surround the satellite.

Saturn is in Sagittarius, a little to the east of Jupiter. On the 15th, the apparent diameter of the planet will be 16″·8, and the major and the minor axes of the outer ring respectively 42″·4 and 17″·6. The ring is widely open, with the northern side towards us.

Uranus is now fairly well placed for observation, being in opposition on the 6th, but like Jupiter and Saturn, rather low in the sky. The path of the planet is a short westerly one in the most southerly part of Ophiuchus; it will be found to the west of the stars ξ and δ, roughly equidistant from them, and at a distance a little greater than that between the two stars.

Neptune is in conjunction with the sun on the 21st, and cannot be observed.

THE STARS.—About 10 P.M., at the middle of the month, Cygnus will be in the east; Lyra will be high up, a little to the south of east; and Aquila will be nearly in the same direction, but lower. Near the meridian will be Hercules, Corona, Ophiuchus, Libra, and Scorpio. Arcturus will be a little west of the meridian, Virgo rather low in the south-west, and Leo almost due west.

Chess Column.

By C. D. LOCOCK, B.A.

Communications for this column should be addressed to C. D. LOCOCK, Netherfield, Camberley, and be posted by the 10th of each month.

Solutions of May Problems.

(Mrs. Baird.)

No. 1.

1. B to QB2, and mates next move.

No. 2.

Key-move.—1. B to Kt2.

If 1. . . P to R4, 2. Kt to Kt5.
1. . . P to B5, 2. R to K4ch.
1. . . P × P, 2. Kt to Q8.
1. . . P to Kt4, 2. P × P en passant.

The following are at present the leading scores in the Solution Tourney:—

Twenty-seven points.—S. G. Luckcock, J. T. Blakemore, G. W., C. Johnston, A. C. Challenger, W. Jay

Twenty-six points.—J. Baddeley, H. Le Jeune, G. Groom, F. J. Lea, W. de P. Crousaz, W. H S. M., F. Dennis, C. C. Massey, Eugene Henry, A. J. Head, J. Sowden, G. W. Middleton, E. Hunt, Vivien H. Macmeikan, J. E. Broadbent, C. Child.

Twenty-five points.—Endirby.

Twenty-four points.—C. F. P., G. A. Forde (Capt.), A. H. Machell Cox, Alpha, H. Boyes.

Twenty-three points.—A. E. Whitehouse, J. M. K, W. Nash, C. C. Pennington.

Twenty-two points.—F. A. Wilcock, who did not attempt the January problems, but has since scored the maximum number of points.

[All the above score 5 this month, with the exception of Endirby, 4 (1 point deducted for incorrect claim for a second solution), and A E. Whitehouse, 2.]

CORRECT SOLUTIONS of both problems have also been received from W. Boyd and A Kempster.

Endirby.—After 1. Q × Bch, K to Q3, there is no mate.

W. H. S. M.—The law concerning post-marks was stated very clearly before the competition began. There can be no doubt as to its interpretation in the case you mention.

F. O. Wilhelmy.—April solutions correct; too late to acknowledge last month.

W. H. Gundry.—Many thanks. It is marked to appear later in the summer.

XUM

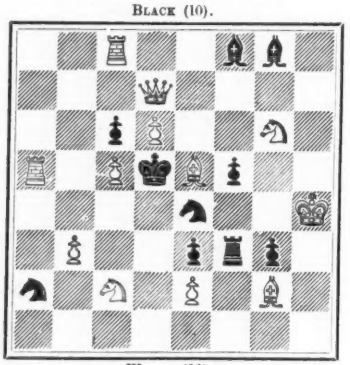
W. Boyd.—Your problem beginning with a check is not sufficiently deceptive. In addition there is a quadruple mate after 1. . . K to Q4.

PROBLEMS.

No. 1.

By Mrs. W. J. Baird.

BLACK (10).



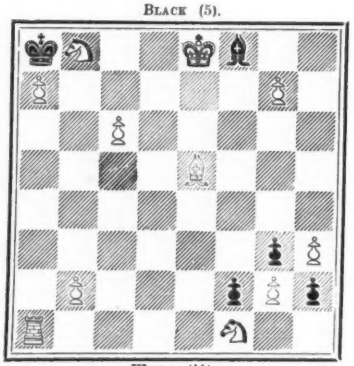
WHITE (12).

White mates in two moves.

No. 2.

By D. L. Anderson.

BLACK (5).



WHITE (11).

White mates in three moves.

CHESS INTELLIGENCE.

The North *v.* South Correspondence Match came to a conclusion on April 15th. Five games remain to be adjudicated, but their result cannot affect the match, which has been won by the South. The score of the 95 finished games is as follows:—

NORTH.			SOUTH.		
A. Burn, Liverpool	...	1 ½	W. H. Gunston, Cambridge	...	0 ½
G. A. Schott, Bradford	...	0 0	C. D. Locock, Surrey	...	1 1
F. Downey, Newcastle	...	0 0	W. Ward, London	...	1 1
F. E. Spedding, Liverpool	...	0 –	D. Y. Mills, Gloucestershire	...	1 –
F. P. Wildman, Leeds	...	0 1	H. W. Trenchard, London	...	1 0
C. C Carroll, Manchester	...	1 1	T. Physick, London	...	0 0
Rev. W. C. Palmer, Manchester		0 0	F. J. H. Elwell, Southampton		1 1
J. Wilson, Lincoln	...	0 0	S. Passmore, London	...	1 1
W. Atkinson, Hull	...	1 1	H. Brewer, London	...	0 0
J. Birks, West Hartlepool	...	– –	H. F. Cheshire, Hastings	...	– –
C. H. Wallwork, Manchester	...	0 0	A. E. Tietjen, London	...	1 1
W Brunton, Thornaby	...	1 1	P. Howell, London	...	0 0
J. A. Woollard, Keighley	...	1 –	C. E. C. Tattersall, London	...	0 –
E. G. Sargeant, Newcastle	...	0 0	W. T. Pierce, Kent	...	1 1
H. E. Wright, Stockton	...	1 1	C. J. Lambert, Exeter	...	0 0
C Coates, Manchester	...	0 0	H. E. Moore, Bristol	...	1 1
Dr. Shaw, Liverpool	...	0 0	F. P. Carr, London	...	1 1
J. Rogers, Lincoln	...	0 0	C. J. Woon, London	...	1 1
F. H. Wright, Wakefield	...	1 0	E. Emery, London	...	0 1
P. R. Clifford, Huddersfield	...	0 ½	A. Curnock, London	...	1 ½
Dr. Lowenthal, Liverpool	...	½ 0	A. A. Bowley, Brighton	...	½ 1
J. Musgrove, Leeds	...	½ 1	F. N. Braund, Brighton	...	½ 0
T. H. Lambert, Manchester	...	0 0	R. C. Turnbull, London	...	1 1
W. J. Greenwell, Newcastle	...	0 ½	F. H. Miles, Hastings	...	1 ½
G. H. Harrison, Sheffield	...	1 0	S. Van Gelder, Bath	...	0 1
H. Doyle, Egremont	...	1 ½	F Anspach, London	...	0 ½
J. Foulds, Bradford	...	0 0	M. Michael, London	...	1 1
S. Keir, Lancaster	...	1 0	Dr Deighton, Cambridge	...	0 1
J. S. Brooksbank, Cumberland		0 ½	W. E. Vyse, London	...	1 ½
J. Nicholson, Newcastle	...	1 1	F. W. Flear, Huntington	...	0 0
R. H. Philip, Hull	...	½ 0	H. Erskine, Brighton	...	½ 1
J. Higgins, Cumberland	...	0 1	W. Bridger, Sussex	...	1 0
P. R. England, Liverpool	...	0 1	Dr. Dunstan, London	...	1 0
W. Gledhill, Dacre, Bks.	...	½ 1	T. B. Girdlestone, London	...	½ 0
H. Greenwell, Newcastle	...	1 ½	H. G. Lee, Bath	...	0 ½
F. C. Howell, Leeds	...	1 –	H. L. Bowles, London	...	0 –
S. M. Cockin, Wakefield	...	0 ½	T. M. Friedmerger, Hastings		1 ½
A. E. Greiz, Birkenhead	...	0 0	T. W. Newman, London	...	1 1
J. J. Shields, Hull	...	1 1	T. E. Hayden, London	...	0 0
W. D Hawdon, Newcastle	...	0 0	J. A. Watt. Hastings	...	1 1
M. Jackson, Hull	...	1 1	H. D. O'Bernard, Honiton	...	0 0
F. Stainsby, Middlesboro'	...	1 1	F. Purchas, Brighton	...	0 0
W. Nixon, Newcastle	...	½ 1	G. W. Williams, Essex	...	0 0
C. W. Roberts, Bedford	...	1 0	Col. Chisholm, Cheltenham	...	0 1
C. J. B. Lowe, Manchester	...	0 ½	T. Taylor, Plymouth	...	1 ½
D. Cock, Spennymoor	...	1 ½	G. B. Capel, Bath	...	0 ½
M. Holt, Manchester	...	0 0	G. V. Sutton, London	...	1 1
C. Croft, Burley-in-Wharfdale		1 1	J. A. Green, London	...	0 0
W. H. Burgess, Manchester	...	0 ½	Col. Law, Gloucestershire	...	1 ½
C. Platt, Carlisle	...	0 ½	W. Mears, Torquay	...	1 ½
Total	...	41½	Total	...	53½

The final score is—South, 47; North, 43.

The Sixth Anglo-American Cable Match took place on April 19th and 20th. Fortunately Mr. Blackburne found himself able to play after all, and the British team was greatly strengthened by the inclusion of Mr. Mason. As the Americans had won in the two previous years, it was of the utmost importance that their opponents should at least draw the present match and thereby prevent the Newnes Challenge trophy from leaving these shores for ever. This, after a hard struggle, they succeeded in doing, the score being as under:—

GREAT BRITAIN.		U.S. AMERICA.	
J. H. Blackburne	0	H. N. Pillsbury	1
J. Mason	1	J. W. Showalter	0
F. J. Lee	½	J. H. Barry	½
D. Y. Mills	½	A. B. Hodges	½
H. E. Atkins	0	E. Hymes	1
G. E. H. Bellingham	½	H. Voigt	½
W. Ward	1	F. J. Marshall	0
E. M. Jackson	½	S. W. Bampton	½
Herbert Jacobs	0	C. J. Newman	1
R. P. Michell	1	C. Howell	0
Total	5	Total	5

Later in the month a cable match between the American Universities and a team representing Oxford and Cambridge Universities likewise ended in a draw, the score being three games all.

Mr. Lawrence won the City of London Championship (for the fifth time) without losing a single game, winning 18 and drawing 3. The order of the other prize-winners is not yet determined, but Mr. Herbert Jacobs will probably be second; Mr. Ward, 16½, third; Mr. E. O. Jones or Dr. Smith, fourth; and Mr. A. Curnock, sixth.

Miss Finn has won the championship of the Ladies' Chess Club, Mrs. Fagan being half a point behind, and Mrs. Anderson third.

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